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MOTORSHIP

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PROFUSELY illustrated with photographic reproductions of the newest designs in international merchant motorship and Diesel-engine construction and auxiliary equipment.

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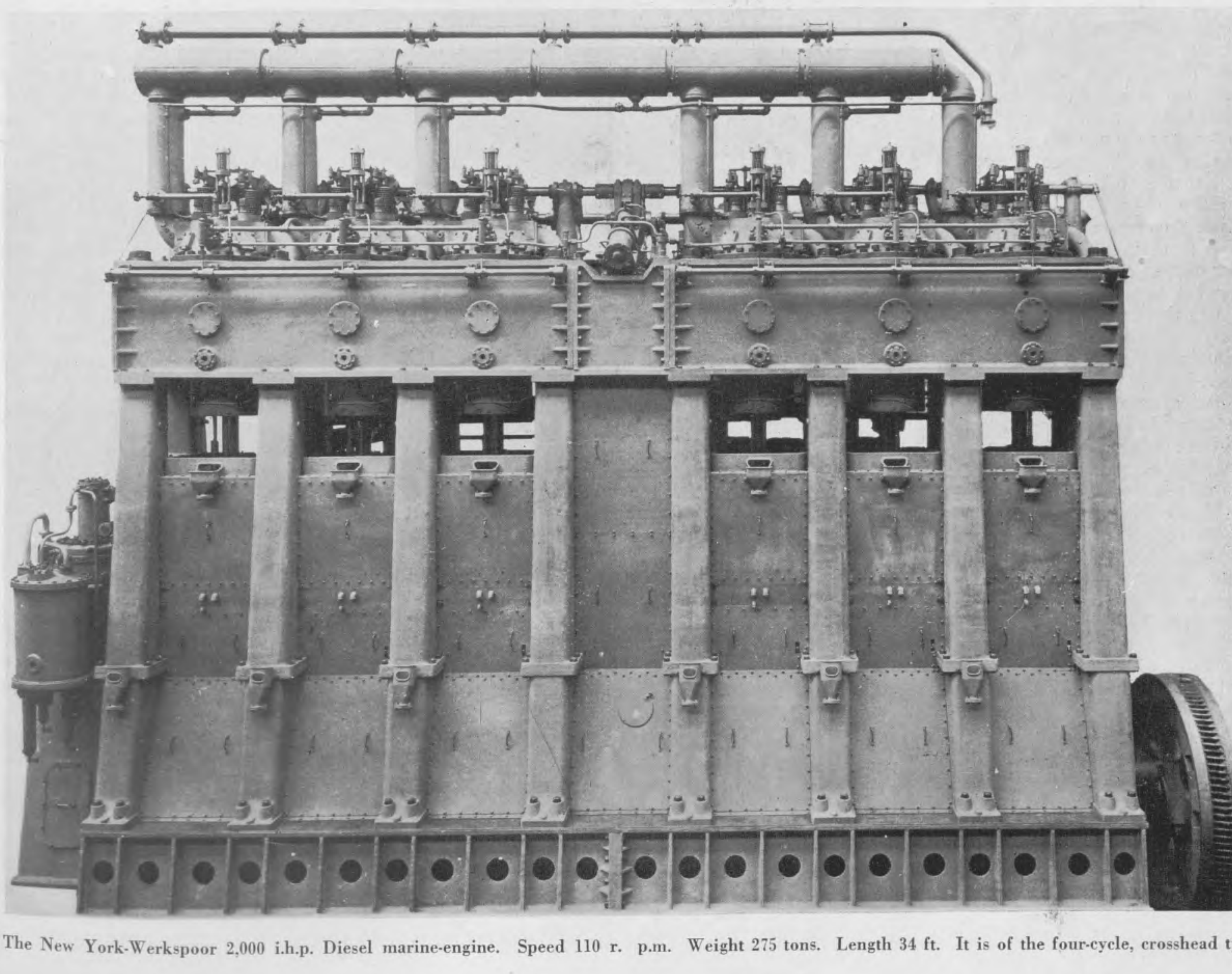
Another Americanization of an European Oil-Engine

Exclusive Illustrated Details of the New York-Werkspoor Diesel Marine Engine—A Six-Cylinder Unit of 2,000 i.h.p. at 110 r.p.m.

ONE firm in this country who has adopted an European Diesel license has followed the licensor's design on two of three engines now building, but is Americanizing the third set, while several domestic concerns have carried out the parent design with exacting precision even to minor details of construction. On the other hand there are a number of domestic engineering and shipbuilding companies who have modified the foreign design before beginning construction in order to bring it into line with the particular requirements of American ship installations as well as shop practice, which differ in numerous respects from those in vogue abroad.

Generally speaking, improved engines have resulted, especially as the licensees have the past experiences of the licensors to guide them as well as the latter's assistance in conjunction with their own bolder engineering policies untrammelled by traditional ultra-conservatism. In any event the changed product has often been better from the aspect of the American operator, and this alone goes not a little way towards ideal reliability in service, although, of course, these matters are more or less individual engineering opinions or problems to be solved by the technical executives of the companies that take the responsibility. Relatively speaking, there is no particularly exclusive virtue in the choice of a design as there are too many good ones, so the preference of one man does not condemn the choice of another, and hindsight is the only arbiter of the wisdom of an engineer's judgment.

Improvement resulting from modification of foreign design may be said to be the case with the first of the two new Werkspoor-type Diesel marine-engines just completed at the plant of the New York Shipbuilding Corporation, Camden, N. J., in which the main features of the parent design have been retained, but sufficient changes have been introduced based on past experiences and on never ceasing progress to make the engine appeal more strongly to American shipowners, and to make it characteristic of American production.



The New York-Werkspoor 2,000 i.h.p. Diesel marine-engine. Speed 110 r. p.m. Weight 275 tons. Length 34 ft. It is of the four-cycle, crosshead type

Without any intention of decrying in any way the Holland-built Werkspoor engine, the marine-construction side of which unquestionably has plenty of excellent and meritorious features particularly applying to European practice, many of which have been followed by other important European concerns. it must be admitted that the combined vertical-and-diagonal steel column arrangement has not altogether received favorable regard from American shipowners and builders. The latter—while continually demanding the impossible, namely, light weight with massive construction—are partial to something that at least looks solid and substantial even though the steel system actually may be stronger than the conventional and more rigid cast-iron framing. Appearance means a lot to the non-technical shipowner, as well as to his advisory naval-architect who, by the way, generally knows little about oil-engines and consequently decides to place his faith in weight for weight's sake and to advocate the same regardless of more important factors that probably are virtually unknown to him.

This is one reason why the New York-Werkspoor design will find ready adoption; because, aside from its engineering merit which will be the real factor, it is to be numbered among the cleanest-looking and best balanced in appearance yet constructed for ship propulsion, although it has yet to prove itself under service conditions. Also it has weight but not too much weight, as the builders have accomplished the unusual by combining robust construction with moderate weight, the engine only weighing 275 short-tons for its 2,000 indicated horsepower (1,540 shaft horsepower) at the normal speed of 110 r.p.m. This means but 275 lbs. per i.h.p. or 363 lbs. per s.h.p. with an efficient propeller speed. Yet it will be noted that in addition to the substantial cast-iron frames on both sides of the engine, steel columns of 4½ ins. diameter run from the upper part of massive cast-iron cylinder boxes, through the frames, down to the under side of the bedplates. Altogether, there are 16 steel columns and the same number of cast-iron frames. All the good Diesel features of the Holland design have been incorporated and only the marine side changed.

Because of the several modifications of the parent Werkspoor engine now existing, it will be of interest to compare their main dimensions and weights, but it should be pointed out that as yet the engines of this size have not actually been constructed by the Newport News Shipbuilding or by the Pacific Diesel Engine Companies, although designs have been laid down.

	Amsterdam Werkspoor	New York-Werkspoor	Newport News-Werkspoor	Pacific-Werkspoor
Indicated horsepower..	2,140	2,000	2,000	2.000
Shaft horsepower.....	1,540	1,540	1,450	1,500
No. of cylinders......	6	6	6	6
Cylinder diameter....	26.378″	27″	27″	27½″
Piston stroke.........	47.244″	47″	48″	47¼″
Revs. per minute.....	110	110	110	110
Piston-speed (per m.).	866′	862′	880′	866′
haft h.p. per cyld ...	257	256	242	250
Ind. h.p. per cyld.....	357	333	333	333
Weight (short tons)...	235 tons	275 tons	240 tons	235 tons
Weight per i.h.p......	220 lbs.	275 lbs.	240 lbs.	235 lbs.
Weight per s.h.p.....	305 lbs.	363 lbs.	330 lbs.	313 lbs.
Mean effective-pressure (per sq. in.)....	72 lbs.	72 lbs.	95 lbs.*	92 lbs.*
Length over-all (without thrusts)........	33′11½″	34′0″	35′8″	36′0″

*m.i.p.

To our knowledge no similarly interesting situation had arisen in any period of the development of the marine Diesel engine, and the position in the shipbuilding world of the companies involved makes the matter of considerable importance, so doubtless much technical discussion will be started among designers regarding the conceptions of these various firms, and the individual applications to American ship installations.

Illustrating design and construction of the Holland-Werkspoor marine Diesel engine for comparison with licensees' modifications

Discussing modifications of foreign Diesel engines, we previously have described the departure from Werkspoor's general marine design made by the Pacific Diesel Engine Company, Oakland, Cal., and it is interesting to record for the first time that one of the two British licensees hitherto adhering strictly to Amsterdam practice is now following a design which much resembles the Pacific-Werkspoor product, indicating that American engineering now makes a wider appeal in as far as English-speaking countries are concerned where engineering practices hitherto have not been so much in accord.

However, it should be made quite clear that all these apparent differences from the Holland design are not really divergences from Werkspoor's conception of Diesel-engine construction, because almost all of the leading features of the licensees' engines are to be found distrbuted among the many types of oil-engines Werkspoor have built during the past fifteen years. In this connection we also reproduce the Holland Werkspoor 2,000 i.h.p. stationary Diesel-engine just to show how much it resembles the New York-Werkspoor engine about to be described, as well as the Pacific-Werkspoor design.

The close relationship of these engines to each other is very apparent. It incidentally indicates that there is complete unity of thought between Werkspoor and its licensees, but that American engineers have been able to select and assemble the best of the basic constructional features, conform them to domestic marine practice, and then incorporate certain original ideas that blend and make a comprehensive whole. It is particularly American to advance whenever possible.

So clearly do the photographic reproductions of the New York-Werkspoor engine illustrate the leading constructional features that drawings are hardly necessary. The engine is of the four-cycle, single-acting type with crosshead construction, and has six-cylinders 27″ bore by 47″ stroke, turning at 110 revs. per minute, which gives a piston-speed of 862 ft. per minute. The mean effective-pressure at normal load is 72 lbs. per sq. inch. Each cylinder has a rated output of 333 i.h.p. but is capable of considerably exceeding this power because the rating of the engine is reasonably conservative. The weight per i.h.p. is 275 lbs., or comparable with the best steam practice if boiler weights are included.

This set is just about to be installed in the freighter ASHBEE, a single-screw geared-turbine boat of 5,740 tons deadweight, built in 1920 and recently purchased by the New York Shipbuilding Corporation from the U. S. Shipping Board for conversion purposes. A second Diesel engine is under construction and will be installed in the freighter JACKSONVILLE, also purchased from the Board. While shipowners are "talking" about converting steamships and otherwise stalling action, this shipbuilding firm, as well as several other American shipbuilders, have demonstrated their faith in oil-engine power and have had sufficient foresight and courage to make the necessary financial investment in conversion jobs, believing that when completed they will have but little difficulty in selling them at prices considerably higher than the current prices of geared-turbine and reciprocating-engined steamers, and at prices which will show a moderate profit on the jobs as well as provide badly needed work for their yards. After her conversion the

ASHBEE will have nearly 1,000 tons greater net-cargo capacity on long non-stop voyages, as well as a better speed on one-third of the fuel-oil consumption. Also, she will have a smaller crew, lower stand-by charges in port and other advantages. We shall deal with the conversion in a later article when the trials have been run.

One can outline the main features of the New York-Werkspoor design in a very few words before going into the more intimate details of the construction. The engine in the main follows conventional Werkspoor practice, but the diagonal steel tie-rods are replaced by heavy cast-iron frames extending from the massive cylinder boxes to the bed-plate. Each frame is in three pieces, an A-section resting on two smaller sections, the whole being bolted down to the bed-plate by the regular Werkspoor steel tie-rods, which run from the top of the cylinder boxes down to the underside of the bed-plates. The cast-iron frames being in three sections enable the crank-shaft to be rolled-out broadside, by lifting the tie-rod which we also term "columns" on one side and removing a lower section of frame.

In fact, it is even more accessible than the parent Werkspoor design, and the latter has always been known for the ease with which any part may be removed for repair or adjustment without disturbing the remainder of the engine. Detachable cylinder-extensions for piston removal, long split-steel tubes for cam-shaft operation, cylinders and cylinder-heads cast integral and mounted in sets of threes in cylinder-boxes or tanks, diagonal-eccentric reversing gear, short-pistons, offset fuel-injection valves, and other well-known Werkspoor features of design have all been incorporated in this engine.

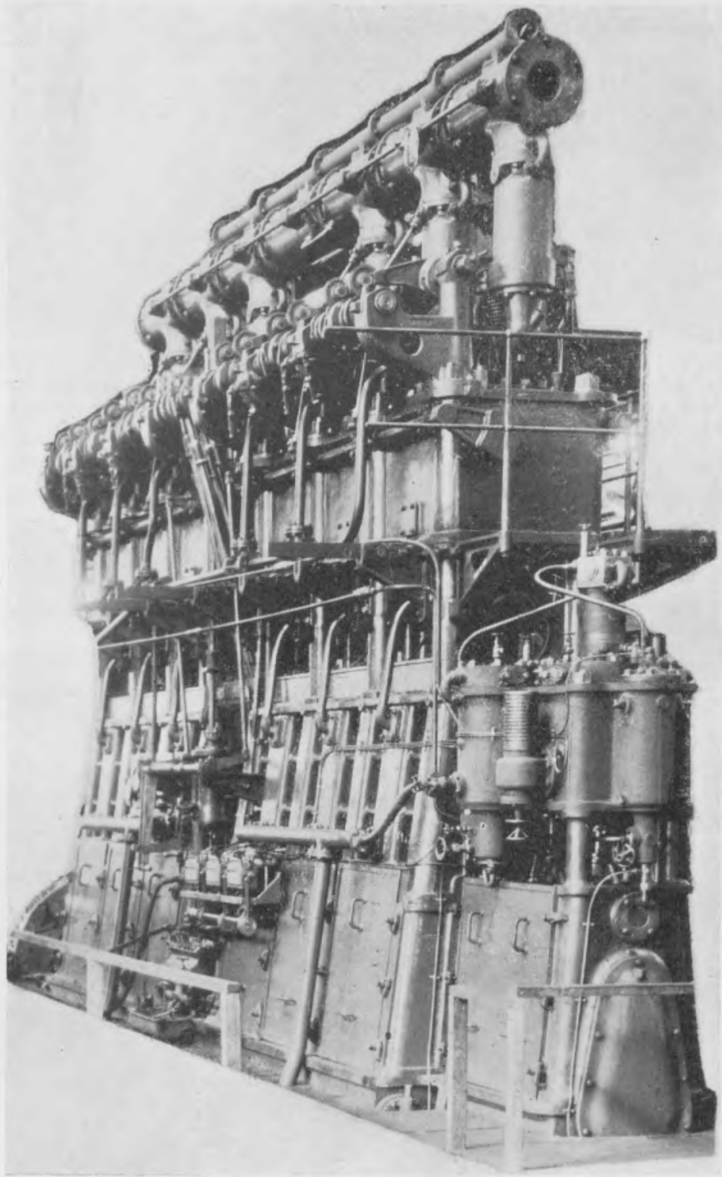
The lowest portion of the cylinder barrel, known as the skirt, is detachable. The piston descends into the extension piece when its crank is on the bottom dead-center, so that, when the extension piece is lowered the piston is entirely exposed and may be drawn out horizontally. By this device much work is saved; to inspect and replace all the pistons of a six-cylinder engine takes less than one working day, no cylinder heads or valve gear having to be touched at all.

Although this is the first Diesel engine built at the Camden plant, no testing is being carried out in the shops, nor will the engines even be run before being installed in the ship, as the builders have sufficient confidence in the Werkspoor design and in their own construction to feel completely certain of the engine working satisfactorily from the start.

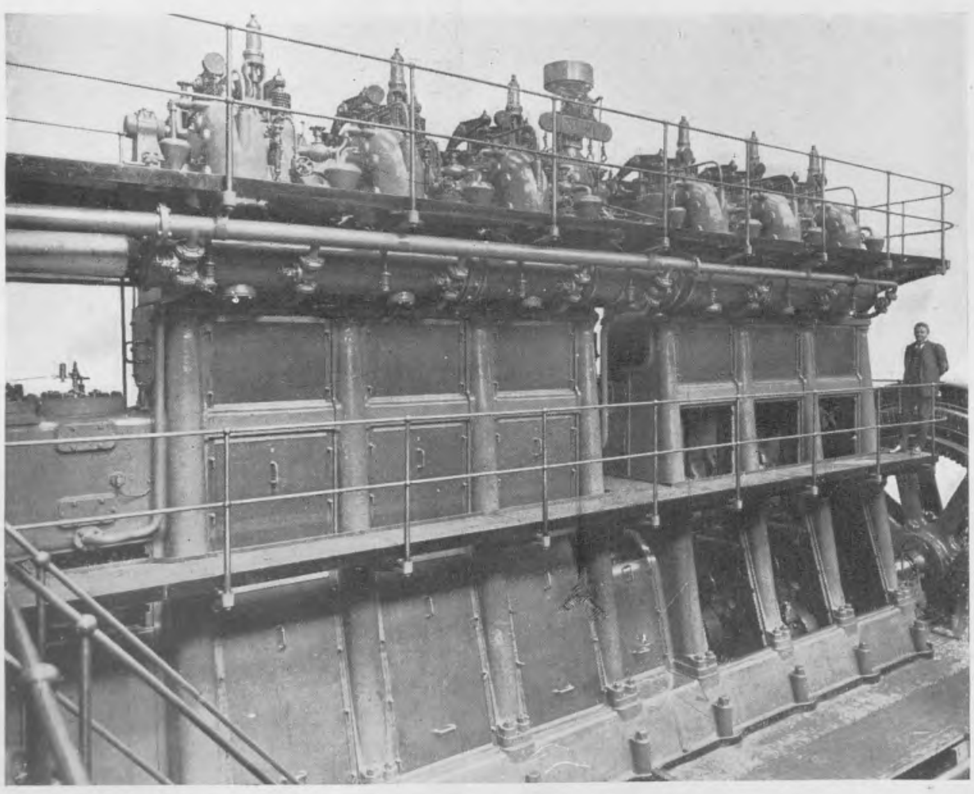
There are only two what may be termed radical departures from Werkspoor design. One of these is the adoption of a separate fuel-pump for each cylinder taking the place of the single pump with distribution system to be found in practically all other Werkspoor engines. It will be remembered that with the Amsterdam arrangement an automatic balanced-vessel is fitted in the engine-room above the level of the main cylinder fuel-valves to which the high-pressure fuel-pump discharges. The steel bottle is balanced on a lever by a counterweight, and when the oil level rises to a pre-determined height it tips the balance and shuts the suction valves in the fuel line. The pressure of the injection air in the fuel-valve is balanced by a connection to the top of the floating vessel from the same system, so that a constant head of oil is maintained, which insures a regular flow to the fuel-valves, regulated by two distributor-boxes with hand adjustment. In this way the engines can be kept running for about twenty minutes should the main fuel-pump be out of action, this giving time to connect up the spare pump before the engine stops.

This is a special system adopted only with Werkspoor engines, but in laying out their plans the New York Shipbuilding Corpn. preferred to adopt the system of a separate fuel-pump for each cylinder which has been practically standardized by every other Diesel engine builder in the world, but considered by the Dutch designers to have too many small valves and other little working parts to make easy the regulation, etc. Whether or not benefits will be derived from the change remains to be seen after the New York engine is in operation, but, from an engineer's standpoint both systems have their particular merits and operate with perfect satisfaction, so this particular modification may be considered of minor importance, and purely one of individual preference.

The second departure is the fitting of a three-stage single-crank compressor at the forward end of the engine, whereas with the Werkspoor marine-en-



The Pacific-Werkspoor Diesel marine engine. Note the three-crank type of air-compressor. Also note the cast-iron frames



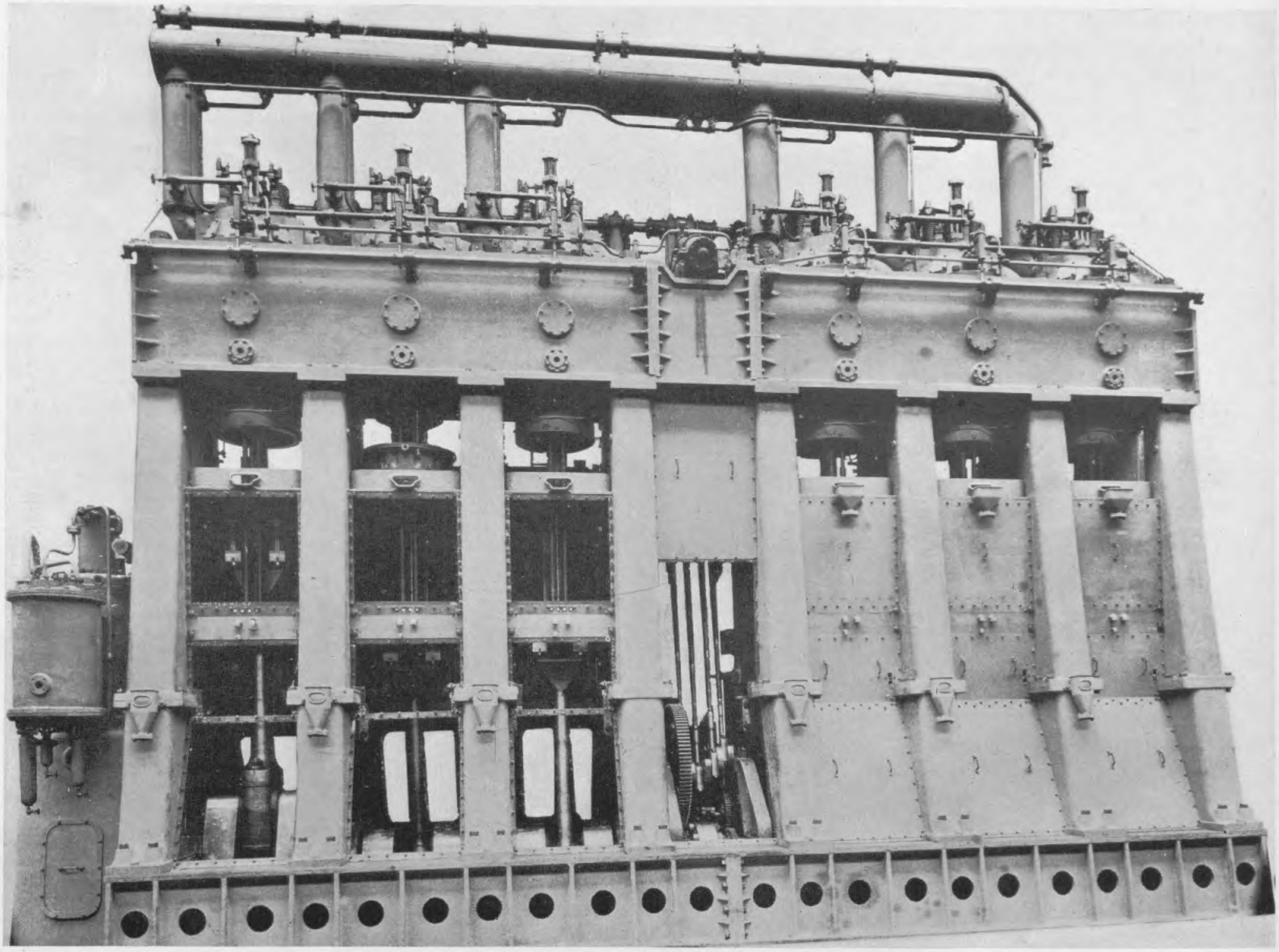
The Holland-Werkspoor 2,000 i.h.p. stationary Diesel engine. Note the substantial cast-iron frames as in the New York-Werkspoor marine engine, and the separate-stage, three-crank compressor as adopted with the Pacific-Werkspoor 1,150 i.h.p. engine illustrated above

gines separate stage compressors driven by rocking-levers off one of the cross-heads is used. On the other hand, the Pacific-Werkspoor engine has a three-crank compressor with individual unit stages at the forward end, as will be seen by the illustration given to denote the feature. It also will be noted that the stationary oil-engine built by the Werkspoor Company has this three-crank compressor.

Although the compressor is mounted at the forward end of the engine, the total length of the New York-Werkspoor engine without thrust-bearings in only 34′, which enables it to be installed in the existing engine-room of the average steamer when a conversion is to be made.

The three-crank compressor appeals to our engineering sense, but it takes up space, and for this latter reason the 2,000 i.h.p. Pacific-Werkspoor design shows the steeple-type compressor.

Cylinder top showing offset fuel-valve, which arrangement provides ample cooling space between the fuel and exhaust valves



View of New York-Werkspoor engine showing oil-tight splash-plates removed to illustrate accessibility of all working parts. The skirt of the second cylinder has been lowered exposing the piston and rings

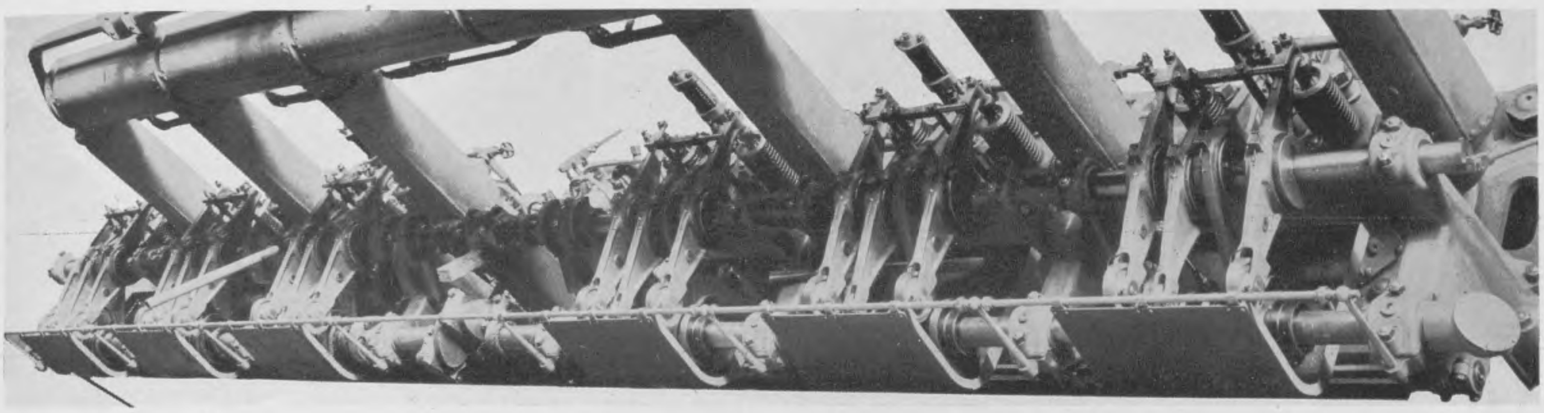
In our opinion, the future tendency will be to drive the air-compressor either by an auxiliary oil-engine or by electric motor. Particularly with twin-screw ships will this be found to be of advantage, because two big air-compressors will be enough to supply both engines, one in operation and the other as a stand-by. Two compressors will also be necessary for the single-screw set, but this applies even when the compressor is on the main engine, as in this case it is necessary to have a stand-by compressor driven by auxiliary power. If we were planning a motorship we should stipulate such an arrangement, unless satisfactory reasons were otherwise proven.

Referring to the illustrations of the New York-Werkspoor engine in which the splash plates are shown removed, the general features of construction are clearly depicted. The cylinder boxes, one for each set of three engines, are supported by the cast-iron A-type frame, the latter being in three sections (one upper and two lower) in order that one of the lower parts may be removed for the purpose of lifting out the crank-shaft. As the 4½″ steel columns run through these frames on either side, it is necessary to raise these columns about 4 ft. when it is desired to lift out the cast-iron frame sections, which is a fairly simple operation. This construction is very rigid.

The six forged piston-rods

The cylinders and cylinder-heads are of the familiar Werkspoor mushroom construction and are cast integral, as the designers consider that the flanges of cylinders with separate heads collect too much heat and tend to prevent effective water-cooling of the combustion chamber at the point where the heat is greatest. The cylinder-box arrangement originated by Werkspoor has since been adopted by a dozen other leading builders, but with detachable cylinder heads.

Removal of pistons is a rapid and easy matter, being, as already described, effected by lowering the cylinder skirt on the under side of the cylinder boxes. Reference to

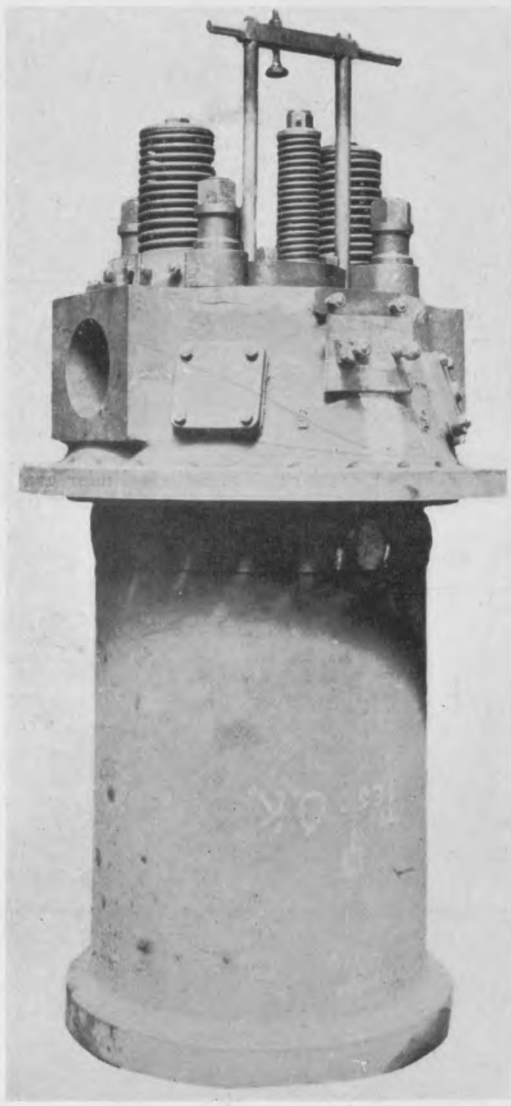


View showing eccentric valve-motion on the cylinder heads

the illustrations of the individual cylinder casting will show that the fuel injection-valve has been offset. This allows of large inlet and outlet valves and at the same time enables a water cooling-space of about 2" between the fuel-injection and exhaust-valve where cooling is most needed and where deposits are liable to collect if the flow of water is retarded by too small a space. Between the two cylinder boxes there is a cast-iron distance-piece, on top of which is mounted the small pneumatic engine for operating the valve mechanism when manoeuvring.

The New York Shipbuilding Corpn. have adopted the diagonal-eccentric system of valve rockers first introduced by Werkspoor in 1919. There is only one cam-shaft, and this does not move either backward or forward as with the old double cam-shafts, nor does it move fore and aft; but there are two sets of cams per valve rigidly secured on it. All the reversing motions are carried out by the valve rockers and double-ended tappet hammers. Like all eccentric movements the action is somewhat peculiar yet very simple. There are four rockers per cylinder for the inlet, exhaust, fuel and air-starting valves, respectively, each rocker being mounted diagonally on an eccentric, and the latter—while secured to the shaft—is free to move in the hub of the rocker.

To shift the rocker-rollers from one cam to another and at the same time change the position of dual tappet ends of the rockers, the rocker shaft is rotated 180 degrees; and the neutral position is at 90 degrees. When the shaft is further turned the rollers are lowered onto the exhaust cams. So easy is this motion that it can be carried out by hand, but for the purpose of facilitating the operation a double-acting air or pneumatic engine with an oil cushion is provided. To the piston of this air engine there is attached a ratchet device working a ratchet-wheel on the rocker shaft for carrying out the 180 degs. turning movement. The setting of the rocker rollers is so arranged that when running in the " ahead " position the face of the roller is square on the cam, but is resting at a slight angle. In actual practice the latter is of little consequence because when the roller is in the " astern " position the wear is exceedingly slight because the engine is running " astern " for very limited periods and only when the vessel is maneuvring in port. In view of this, it was decided not to design the faces of the rollers and the cams whereby they would rest perfectly square on their surfaces in the " astern " position as well as when running " ahead."

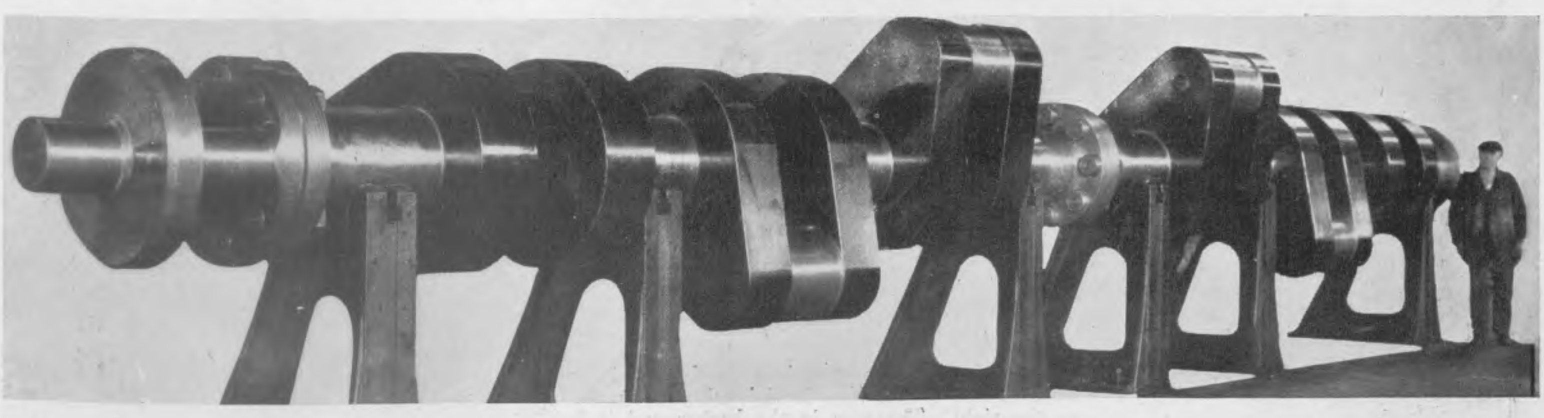


The New York-Werkspoor cylinder and head are cast integral, allowing water cooling space around the hottest part of the combustion chamber

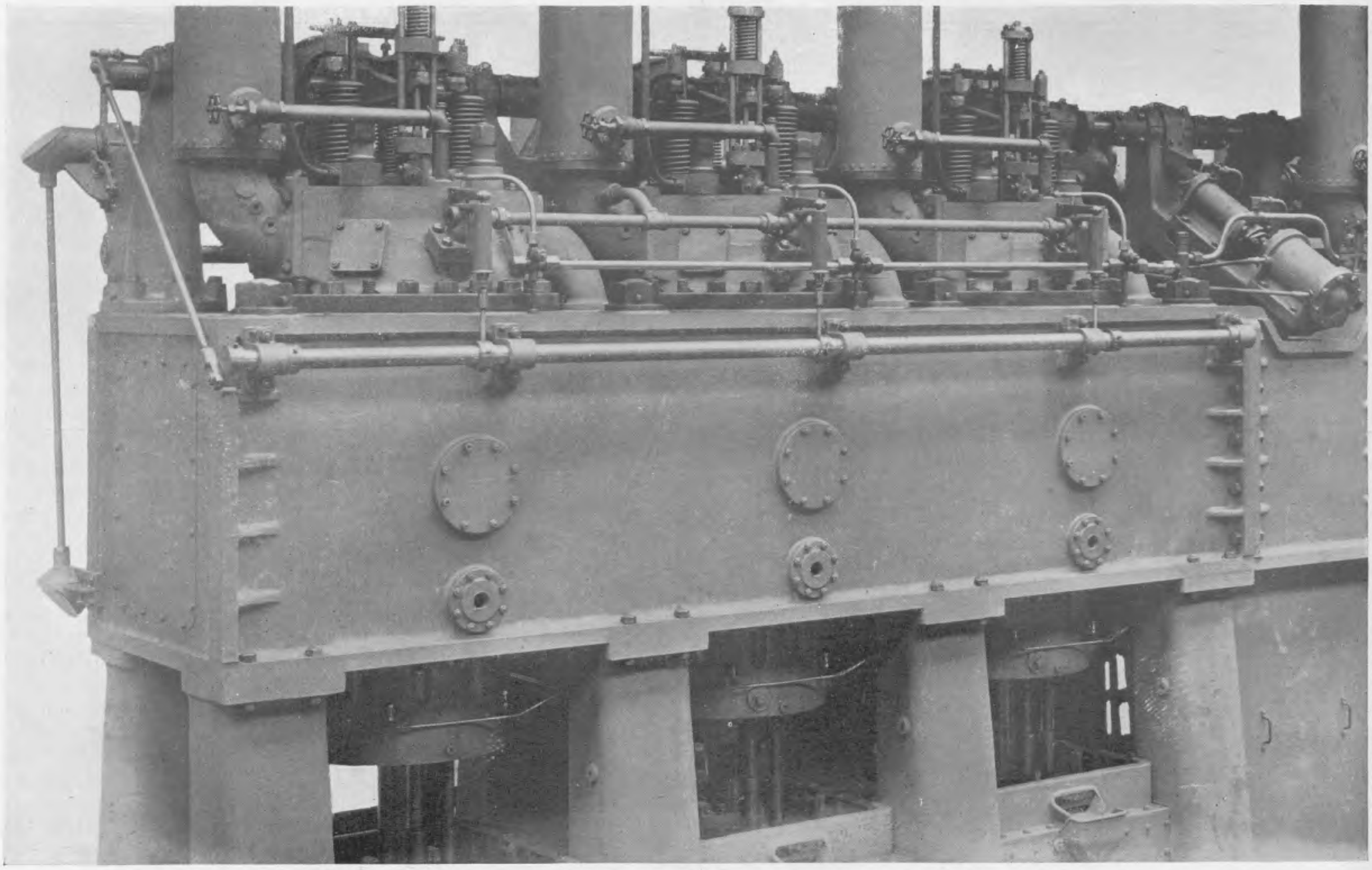
For the cam-shaft operation the Werkspoor system of long split-steel tubes and cranks which pull and not push has been adopted. This system has been fitted on every one of the Werkspoor marine engines built since 1909, and has been adopted by all licensees. There are four rods, each being slotted by a saw cut, pried apart, and made rigid by struts in order to avoid vibration. In operation the movement is very silent and smooth running. We should mention that the small crank-shaft at the lower end of the pull-rods is driven by a two-to-one reduction-gear off the main crank-shaft.

Sea water is used for cooling the pistons as well as the cylinders. For the piston cooling there is a series of " cups " in telescopic tubes which pick up the sea water on each stroke of the piston from a small well which is kept full of water by the piston-cooling pump. On the up-stroke these cups throw the water into the piston and the water then passes out through the outlet set of telescopic tubes to open inspection funnels. Neither the inlet nor outlet telescopic tubes have any stuffing-boxes or glands, nor do they touch each other in motion so that there is no friction.

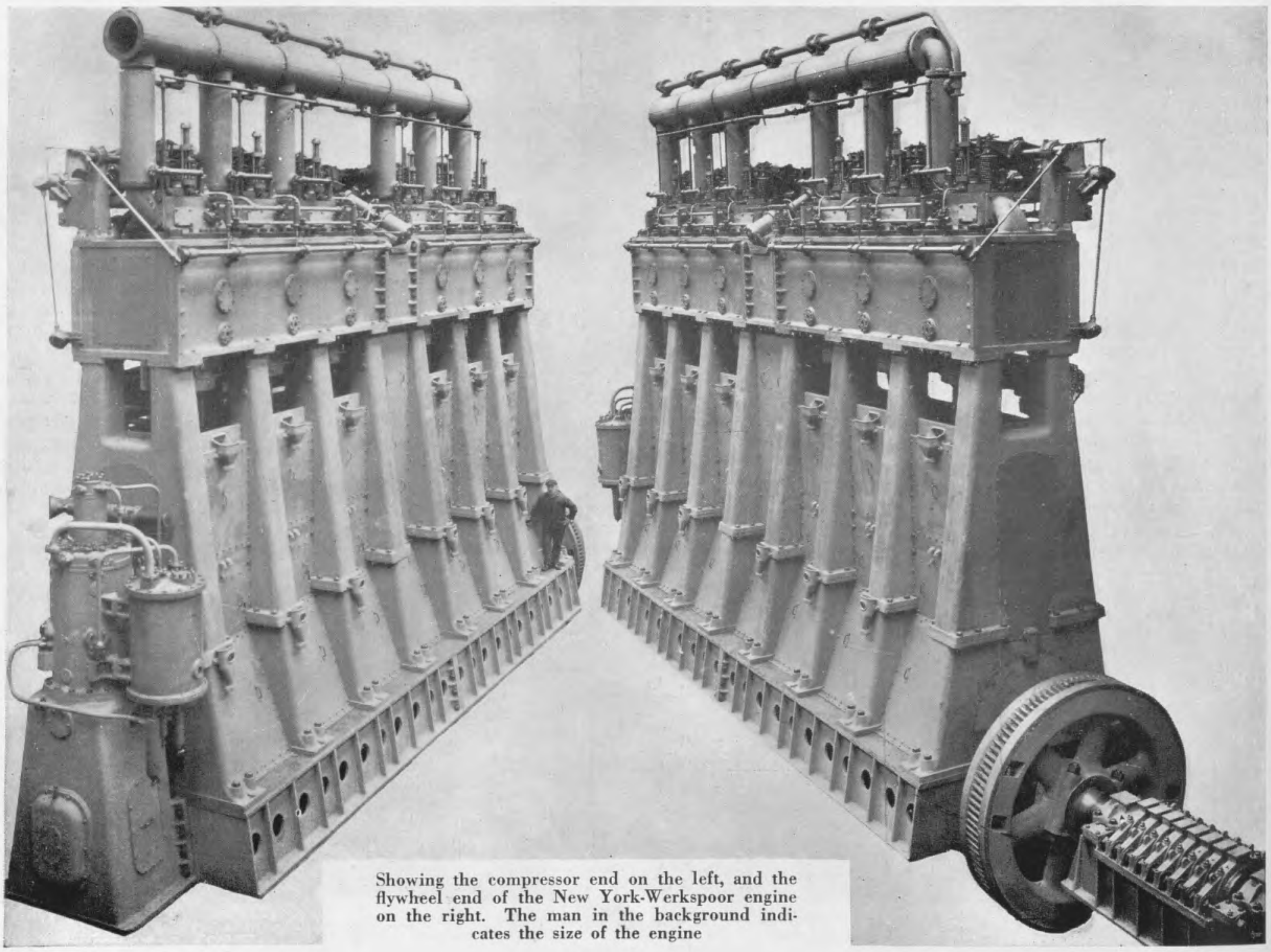
Forced lubrication has been adopted throughout the engine as is consistent with modern practice, and between the cast-iron frames oil-tight plates are mounted, the latter being fitted with inspection doors



The built-up crankshaft of the 2,000 i.h.p. New York-Werkspoor Diesel engine



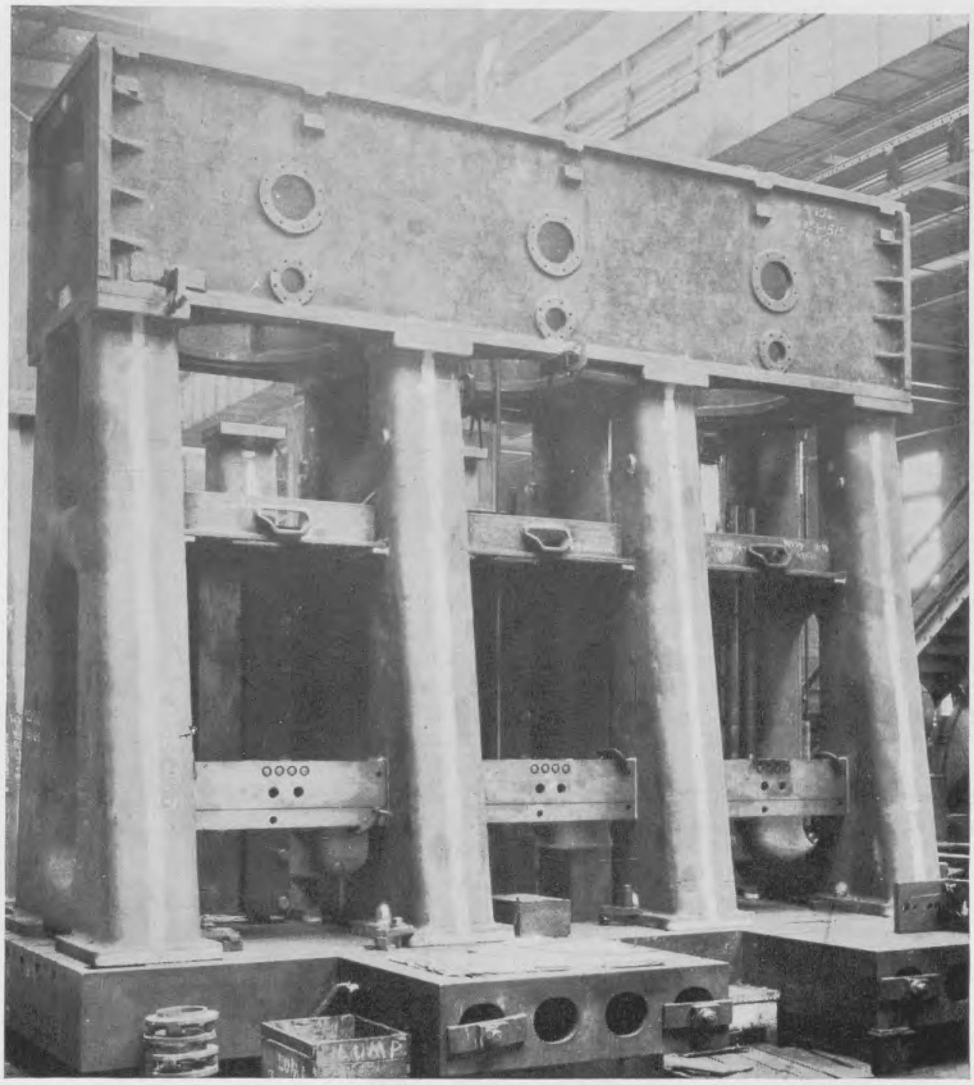
One-half of the upper part of the New York-Werkspoor Diesel engine showing cylinder-box, valves, and the little air-engine (on right) for maneuvring. The tray separating the crank-case from the cylinder can also be seen



Showing the compressor end on the left, and the flywheel end of the New York-Werkspoor engine on the right. The man in the background indicates the size of the engine

which can be removed in a few seconds. For the engine controls a complete system of interlocking devices has been incorporated which prevents possible mistake on the part of the operator. The bed-plate differs in form and construction from the usual Werkspoor marine bed-plate and is of heavier design. It was not the desire of the New York Shipbuilding Corpn. to make any attempt at weight-saving, but to produce a robust engine capable of standing the most severe conditions of operation. Thus their engine weighs 275 tons, compared with 235 tons of the Holland-Werkspoor engine of similar power. Yet their engine is only a half-inch longer than the Amsterdam production.

It will be noted that the old horseshoe type thrust bearing has been adopted, a policy which is also followed by Werkspoor themselves and by the British licensees, whereas the Pacific Diesel Engine Co. uses the Kingsbury single-collar thrust throughout, with the result that several feet of overall length are saved. The lengths of the New York-Werkspoor and Holland Werkspoor engines as quoted above do not include the thrust bearings.



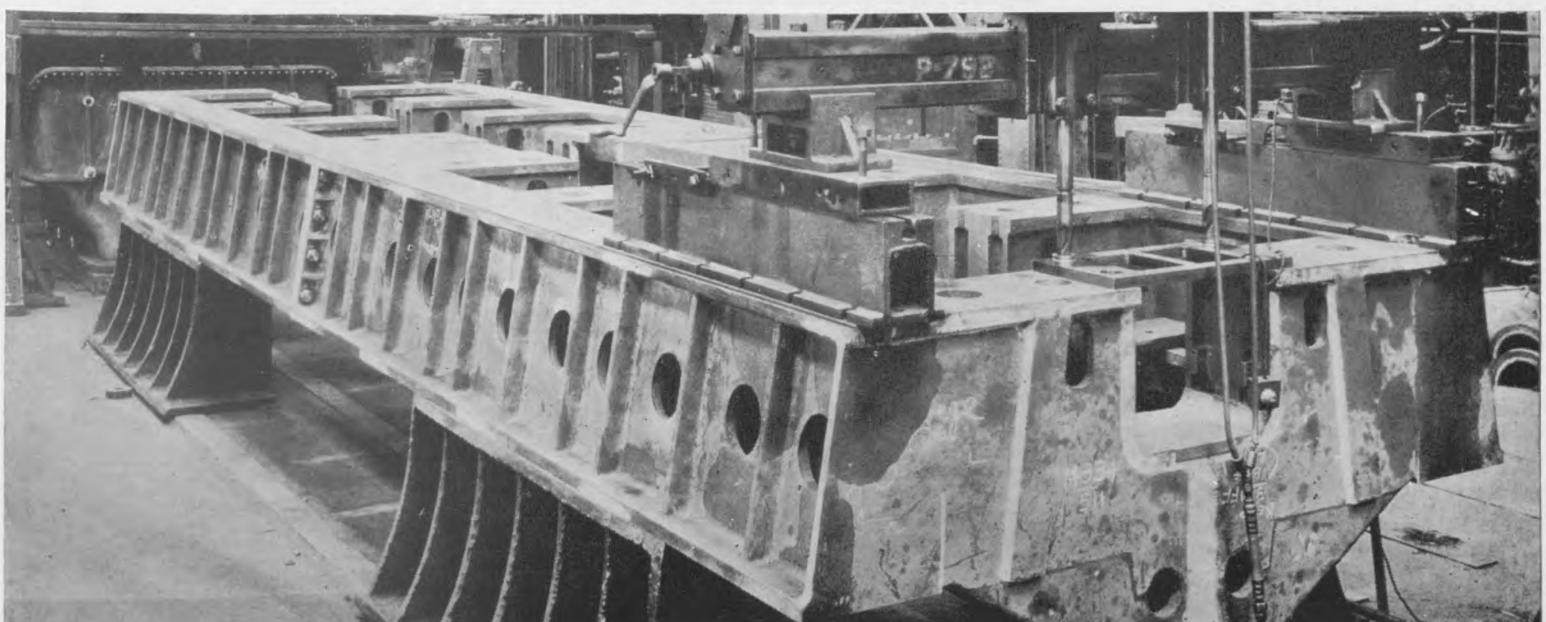
The sturdy strength of the New York-Werkspoor construction is depicted by this illustration of the cylinder box and frames. Steel columns 4½″ dia. run through the latter, absorbing the stresses of combustion

While once more on the subject of length and weight, we are reminded that engineering opinions in shipyard and shipping circles differ. Naval-architects and consulting-engineers in charge of designing ships, but not actually connected with the shipyards, write to the marine journals complaining bitterly that Diesel engine weights are too high and that they occupy too much space. How they arrive at their conclusions and figures is somewhat of a mystery, but does not alter the fact of the apparent sincerity of their belief. On the other hand we have heard experienced shipbuilders, including one of the important executives at Camden, say—"what's fifty tons more or less in a cargo vessel? Is it worth trying to save this quantity in an engine that must often operate continuously for weeks!" In this viewpoint there is concealed a great deal of truth.

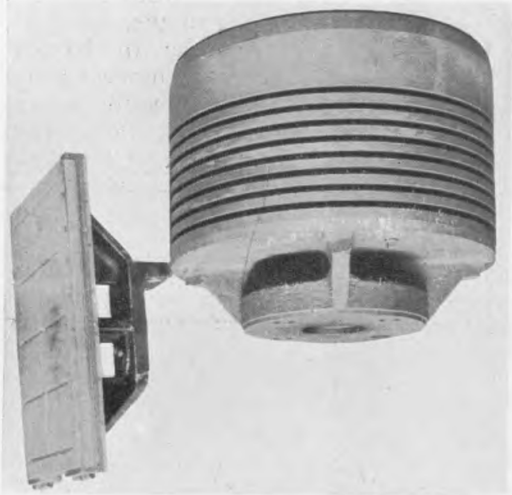
Then again, it does not appear to be of much use endeavoring to save overall length because of the existence of an antiquated British tonnage - measurement ruling applying to all trans-ocean ships regardless of nationality, and in which the advent of the Diesel engine should have produced an official change. Unfortunately there still are many cobwebs entwined around red-tape tied documents at the Board of Trade offices in London. We refer to the regulation making it necessary for the engine-room of a merchant-vessel to be of a certain proportionate length in order to obtain the 32 per cent deduction from the gross tonnage on which harbor and canal dues are estimated. In working out their design the New York Shipbuilding Corporation would seem to have arrived at a happy medium fitting-in with the requirements as they exist to-day, namely, not too light nor too heavy; neither too long nor too short.

A built-up crankshaft has been adopted for the New York-Werkspoor engine, and as can be seen from the illustration given, it is made-up from forged web-blanks and pin billets. Opinion is still in an unsettled stage as to the most desirable type of shaft for long-stroke oil engines as distinguished from short-stroke high-speed engines. For the latter there cannot be much question that a solid-forged shaft in one or more sections is the best.

But, with the merchant-ship class of oil-engine the problem constantly arises: is a solid-forged shaft superior or inferior to a



The New York bed plate differs somewhat from the Holland-Werkspoor design and is heavier



One of the sea-water-cooled pistons, and a cross-head slipper of the 2,000 i.h.p. New York-Werkspoor engine. Eight Davey-Robertson rings are fitted per piston

built-up forged shaft and is a built-up forged steel shaft better than, or not so good as a shaft having cast-steel webs and crankpins in conjunction with forged steel bearing-pins?

The leading forges of the country would do well to make thorough investigations, and if they definitely establish solid forgings to be superior they would not do unwisely if they started and maintained a strong educational publicity campaign. There are no fewer than eighty-four domestic marine and stationary oil-engine builders, some of whom are supplied by almost obscure forges whose lack of real knowledge makes it difficult to produce a crankshaft that will meet the conditions in a truly satisfactory manner. Meanwhile we are inclined to think that the question of price is not an unimportant factor with some engine builders, while others demand the absolute best and make the necessary tests to ensure that they are getting what they call for.

Short pistons and crossheads have been adopted with this engine, which dual feature was first used in marine Diesel-engine construction by Werkspoor, and is now universally adopted for practically all oil-engines turning at 150 r.p.m. or less. Eight 27″ diameter rings are fitted per piston, the uppermost ring being several inches below the piston crown so as to avoid carbonizing of the lubricating oil and sticking the rings. These cast-iron rings are imported from Sweden, and this particular make has been adopted as standard by several leading American oil-engine builders, and there are indications that the majority of domestic piston-ring manufacturers are not fully alive as to the present day importance of the oil-engine industry, a state of affairs we trust will soon be remedied to the benefit of the American trade.

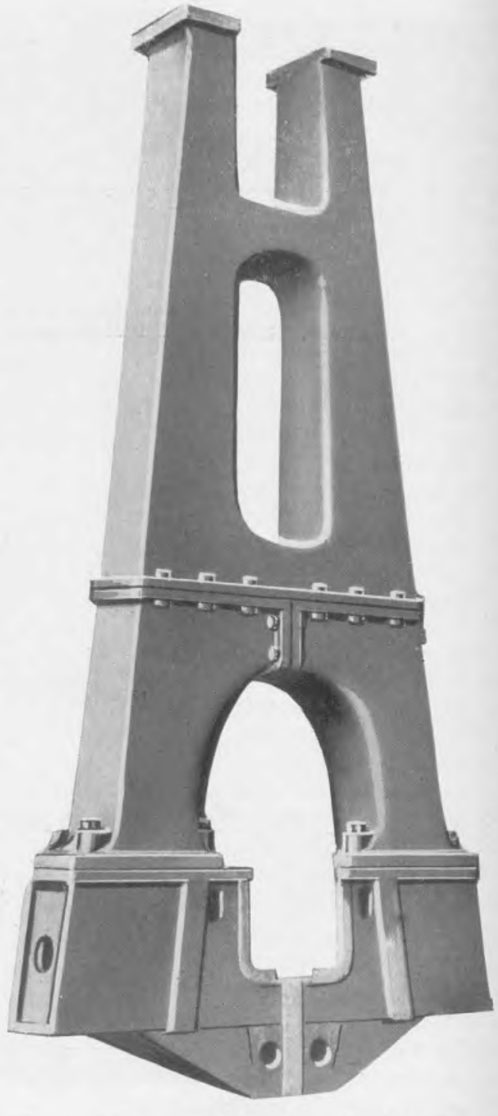
All exhaust-valves are fitted with C.I. deflectors to protect the stems from any injurious effect of gases and heat, especially when burning low grade fuel-oil. All valves have outside springs so they are easily inspected during operation.

Each cylinder is fitted with its individual Richardson-Phenix force-feed lubricator, four feeds leading to each cylinder, entering at potnts most desirable for the lubrication of the piston and for minimum consumption of lubricating-oil. The location of the lubricators on the housings near each cylinder-skirt makes all piping very short and the whole system can be seen by one attendant from one platform. Each individual system is also interchangeable.

The lower main bearing brasses are eccentric in their seats, making it an easy matter to roll out a brass if re-lining is necessary.

Each cylinder is fitted with a relief safety valve, which opens and releases the compression automatically during maneuvering. The fuel-pump plungers are fitted and lapped with care so that no packing is used for seal. This proved a success on the fuel-pump test. All parts are interchangeable. An Aspinall governor is fitted, acting quickly on the fuel-pump suction-valve. Each set of three cylinders is controlled from the engineer's stand to reduce starting-air consumption.

One of the forged-steel connecting rods



Cast-iron frame of the New York-Werkspoor engine. Running thru each frame are two $4\frac{1}{2}''$ steel columns. The latter are often termed vertical tie-rods

In our concluding thoughts we can understand one reason for this new form of design of the Werkspoor engine, aside from the necessity of conformity to local conditions. It is typical of American engineering that while we are always willing to learn from the experiences of those whose studies of a subject have covered a longer period and are more mature than our own (which incidentally accounts for so many European licenses having been sold to this country) we are rarely content to let matters rest at that stage. Our designers usually feel the importance of making an immediate advance in order to go one better than our friends across the "pond."

On the other hand the lesson provided by the errors are speedily learned and remedied, even at enormous expenditure. Contrary to belief prevailing abroad, our engineering companies generally move slowly in adopting anything radically new. Like men who come from Missouri they have to be shown! Hence the distrust with which the Diesel engine was regarded ten years ago in American engineering circles. But once the necessary faith is placed in a design or product, constructional work is often started on a scale and with a vigor almost startling to our European friends.

All these factors are probably underlying elements of the present development of the New York-Werkspoor Diesel engine. Machinery of this type had been successfully driving large merchant-ships on the ocean for five years before this company purchased the building license. This license was then held for nearly seven years before constructional work was undertaken. Now that a start has been made, this great concern not only is building two 2,000 i.h.p. sets, but has bought two hulls, and is carrying-out their conversion entirely with their own funds, without an order, meaning a total investment of not far short of one million dollars.

A set of valve rockers for one cylinder

Combination Tug and Lighter for Cuban American Sugar Co.

New Winton Diesel-Powered Craft from Designs by Cox & Stevens

A CONTRACT was recently awarded to the Vinyard Shipbuilding Co. of Milford, Del., for a combination lighter and towboat, designed by Cox & Stevens, who will also superintend the construction of the vessel. She has been ordered by the Cuban American Sugar Company and is to be of wooden construction of the following dimensions:

Length overall	90′0″
Length on waterline	85′6″
Breadth moulded	22′0″
Depth (top of keel to top of deck beam at side	10′10″
Draft	8′0″

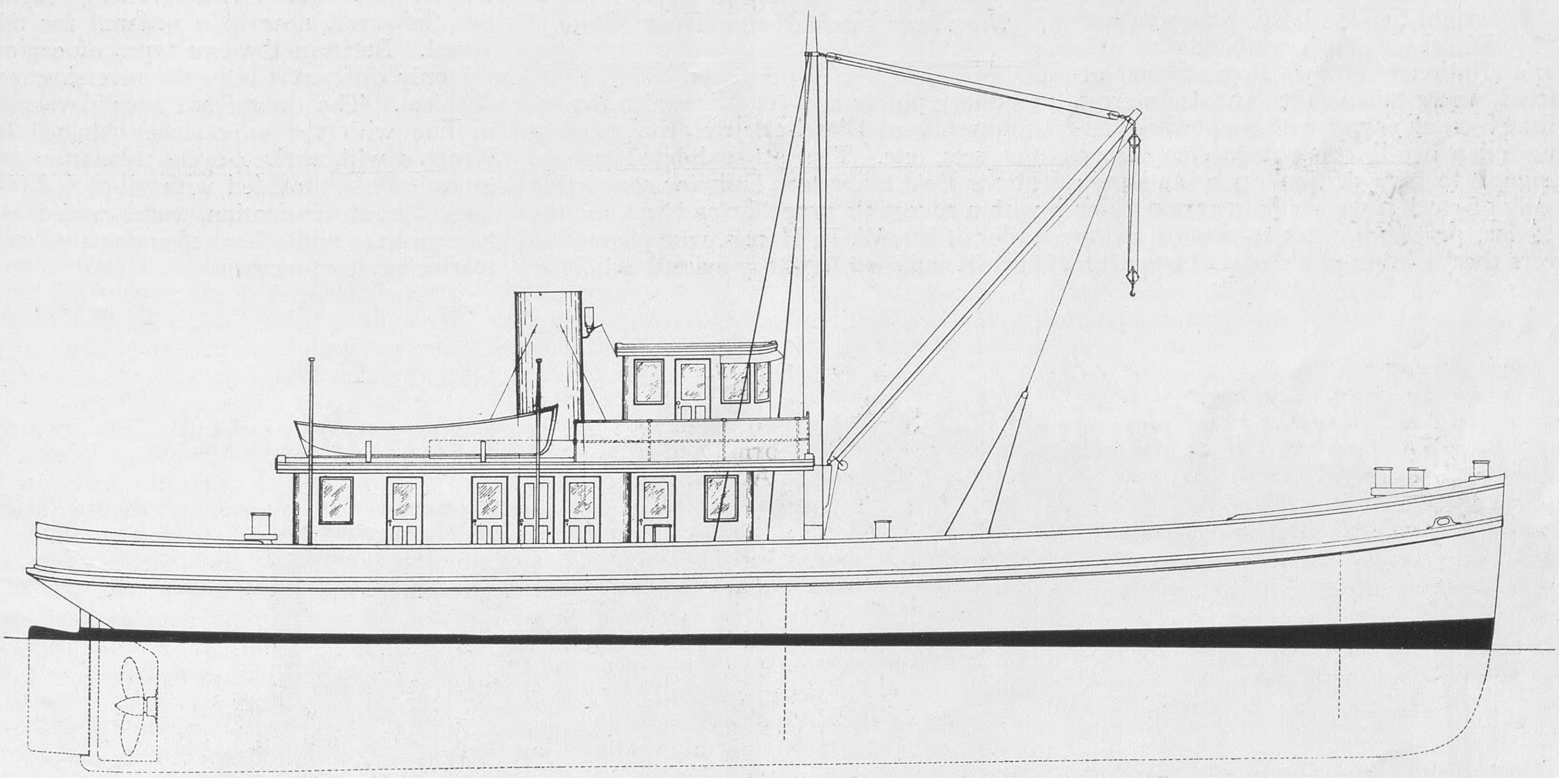
Being intended for use both as a lighter and a towboat, and in the course of her regular service having to spend considerable time in open water, her designers have laid down a strong craft with powerful sections, considerable freeboard, and sheer.

She is of the conventional lighter type, with machinery aft, derrick mast and boom at forward end of house, and cargo hold forward, as well as stowage for deck freight. Water tanks of 500 gallons are provided under the after deck, and fuel oil tanks of three tons capacity, lubricating-oil tanks of 120 gallons capacity, as well as tankage for kerosene and gasoline are provided, all of steel construction except the gasoline-tank which will be of copper.

She will be equipped with a main-engine of the Winton Diesel reversible-type, to deliver 225 b.h.p., with air-compressor, fuel-oil service and transfer-pumps and all the necessary equipment for complete installation. Electric light will be produced by a 5 kw. Winton generator-set, using kerosene as fuel. There will be a hoisting-engine driven by oil engine.

The after-deck is left clear for towing purposes and is fitted with heavy towing-bitts; a cargo-winch is placed aft of the mast, the upper-deck being carried over at this point to afford protection from the weather, and the whole deck forward of the house is left clear for the stowage of cargo. Forward on the centerline is a heavy pair of bitts of the regular towboat type, and all the necessary and usual chocks and cleats and deck fittings are included.

The selection of oil-engines for this craft is another proof of the constantly increasing demand for this type of machinery which, notwithstanding its somewhat higher first cost, has so many advantages, particularly with respect to fuel consumption and economical operation, that the average company having in mind the purchase of new equipment, will usually find, after thorough study of the situation, that an oil-engine will best meet its requirements. It is interesting to note that on this small craft it will be possible, even when water and fuel tanks are full, to carry approximately 100 tons of cargo. This would have been an impossibility on the given dimensions had steam machinery been employed and an equivalent steaming-radius been provided. It was an article on a motor tug in MOTORSHIP that created the Cuban American Sugar Co.'s interest in oil-engine power for their new craft.



Profile of Winton Diesel Tug and Lighter for Cuban American Sugar Co.

AMERICAN MOTORSHIP "FRANK LYNCH" RUNS TRIALS

First of Steamers Converted to Pacific-Werkspoor Diesel Power by Benson Lumber Co.

Trials of the converted Lake-type steamer FRANK LYNCH were run at the beginning of March, the vessel making 10 knots over the measured mile course. In this ship a six-cylinder, four-cycle crosshead type Pacific-Werkspoor Diesel engine of 850 shaft h.p. at 135 r.p.m. is installed. This is one of its three oil-engines of this power and make purchased, as well as the steamer hull, from the U. S. Shipping Board by the Benson Lumber Co. of San Diego, Cal., the first converted ship being named after the president of the company. This vessel has now gone into service and her first port of call is Seattle to load 1,700,000 ft. of lumber for Redondo and San Diego.

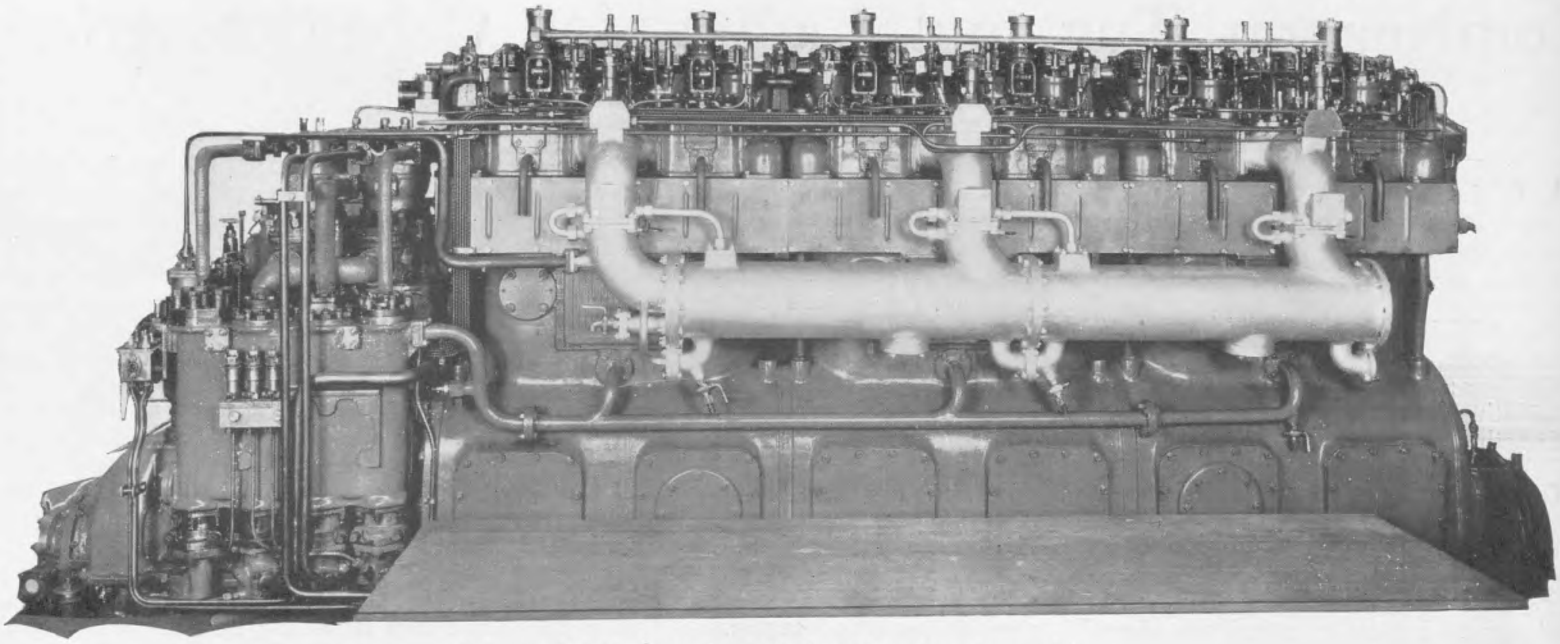
SUN SHIPBUILDING CO.'S THREE CONVERSIONS

Regarding the three 3,000 i.h.p. Sun-Doxford Diesel marine engines now under construction at the Sun Shipyard at Chester, Pa., these will be installed in the tankers BIDWEL and MILLER COUNTY, each of 10,254 tons d.w.c. and in the freighter CHALLENGER, 11,850 tons d.w.c., all of which at present have steam machinery. These vessels have been purchased from the Board by the Sun Shipbuilding Co. for conversion purposes, and after the Diesel engines are installed will be sold. As soon as the first installation is completed full particulars will be published in this magazine.

The Doxford opposed-piston marine oil-engine will be constructed under license by Richardsons-Westgarth & Co., Ltd., who are also building Beardmore-Tosi Diesel engines under license for some motorships for the Furness-Withy Line. Furness-Withy have adopted both types of engines for their vessels.

SUMNER ENGINE FOR TUG

The Foss Launch & Towing Company, Tacoma, Washington, have ordered a 250 h.p. Sumner oil-engine for installation in their tug Foss No. 18. She is 69′ long, 18′ breadth and 7′ 9″ depth, and was formerly powered with a distillate-engine. The Sumner oil-engine is being built by the Todd Dry Dock & Construction Corp. of Tacoma, Wash., for the Sumner concern.

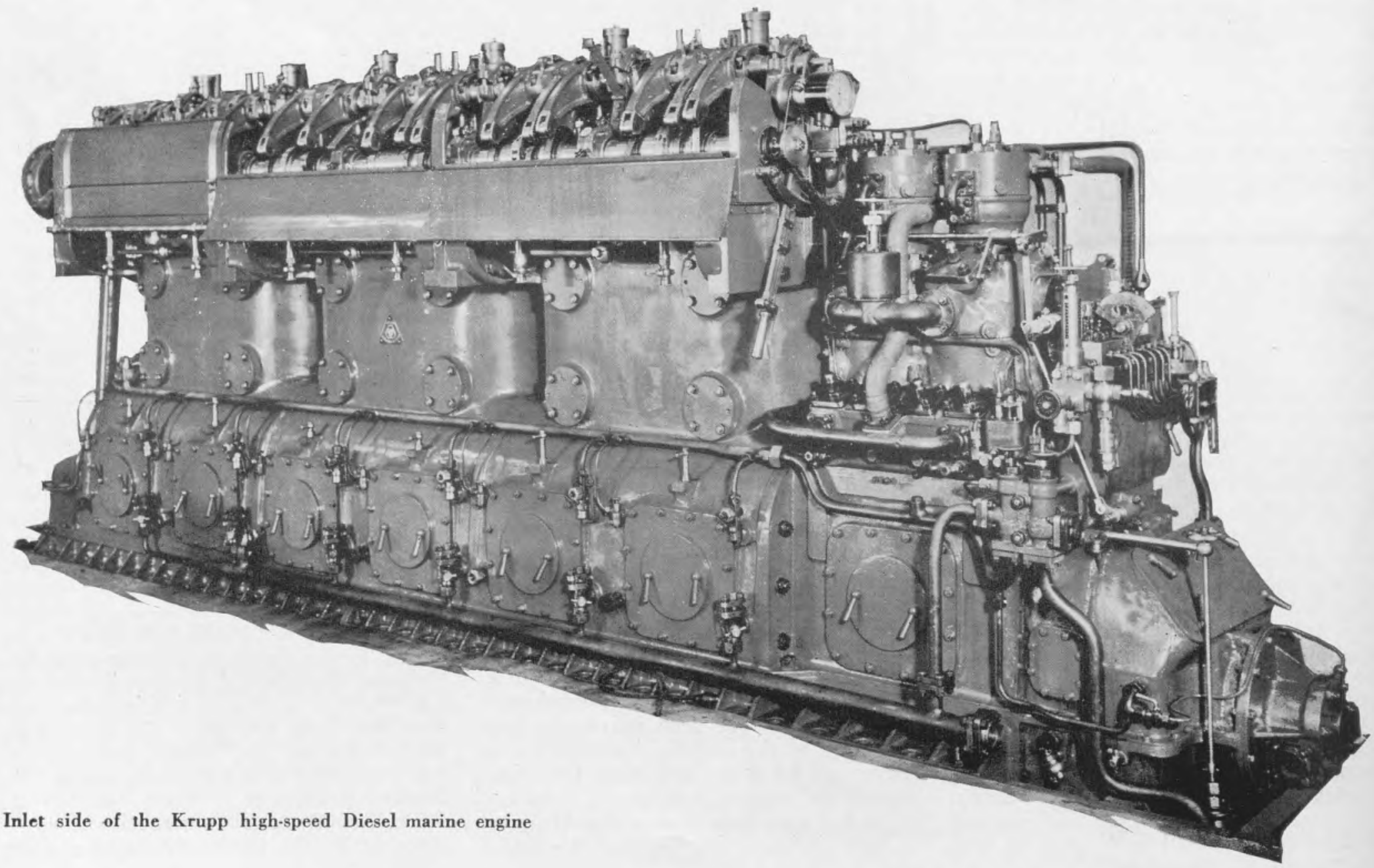


Exhaust side of the Krupp high-speed Diesel marine engine

Krupp Oil-Engine for Yachts

The Only Diesel Engine Exhibited at the New York Motor Boat Show

On account of its relatively light weight the 450 b.h.p. Krupp marine Diesel engine exhibited at this year's National Motor Boat Show attracted more than the usual interest. It is an 8-crank engine with six power-cylinders and a two-throw 4-stage compressor. Designed to turn at 400 r.p.m. and built largely of steel, it weighs only 33,000 lbs or 73½ lbs. per b.h.p. Its sphere of utility covers the yachting needs of full power or auxiliary power and comprises also the requirements of Diesel-electric drive, generator sets, etc. The set exhibited at the Motor Boat Show was built for connection with a reversible propellor and was for the order of Mr. W. H. Hanan, who planned to have it installed in the 3-masted schooner DAUNTLESS. A direct-reversing engine has, however, now been ordered for this vessel. Between the two types of engine, the only difference is in the reversing mechanism. The design has been developed in line with the experience obtained by Krupp's with their 4-cycle submarine engines. It is provided with oil-cooled pistons, forced lubrication, water-cooled exhaust valves and other refinements of submarine engine practice.



Inlet side of the Krupp high-speed Diesel marine engine

Double-Acting Diesels for New Liner

Swedish-American Line Places Order for Transatlantic Passenger Liner of 17,000 Tons Gross and 13,000 Shaft H.P. on Twin Screws—Four-Cycle Engines to Be Built by Burmeister & Wain and the Ship by Armstrong-Whitworth & Co.

IN about eighteen months a large smokeless and probably funnelless passenger liner will cruise into New York harbor and drop anchor. She will be the 17,000 gross tons fast Transatlantic passenger vessel which the Swedish-American Line has just ordered from Sir Wm. Armstrong, Whitworth & Co. of Newcastle-on-Tyne, England for delivery, September, 1924. The engines of this vessel are particularly noteworthy as they are of the double-acting four-cycle Diesel type and will be constructed by Burmeister & Wain of Copenhagen, who for some time past have been experimenting with a single cylinder 1,000 h.p. double-acting engine, as related in our last issue.

The new motor vessel is for service between Sweden and New York and will be approximately 560′ long by 71′ breadth and 29′ draft. She will be the last word in naval architecture, so will be modern in all respects.

Accommodations for 1,660 passengers will be provided, represented by state rooms for 560 first and second class, and quarters for 1,100 third-class passengers. The power to be installed is guaranteed to give a speed of 17 knots. It is anticipated the fuel-consumption will not exceed 50 tons per 24 hours compared with 130 to 150 tons for a steam turbine engined ship of the same power.

Announcement of the decision to use double-acting engines in this vessel has taken the marine world by storm and evoked much wondering comment. It has led also to a lot of foolish vaporing.

From an engineering standpoint there is absolutely nothing experimental in the construction of double-acting four-cycle engines, albeit the application to marine work of the experience gained with this class of machinery on land will represent a new achievement.

Double-acting Diesel engines of the four-cycle type have been used in stationary power plants for nearly 15 years past and have been giving eminent satisfaction. They have been built naturally only in the larger powers—from about 1,000 b.h.p. per crank and up. Over 10 years ago we inspected installations in Germany where such engines were operating, and found in one instance that a cotton-spinning mill was entirely dependent on one double-acting Diesel engine, with no other power unit in reserve and no possibility of getting electric power in an emergency. Evidence of that sort shows beyond cavil how reliable is the operation of such engines.

Long before the war started in Europe a number of the firms building marine Diesel engines over there had constructed single-crank double-acting four-cycle engines for test purposes. Polar, Nobel and Werkspoor each had one; and, if memory serves aright, Burmeister & Wain had already started the trials which have culminated in their obtaining the order for the machinery in the big vessel for the Swedish-American Line. Other firms went ahead with the construction of double-acting two-stroke engines in very large powers.

In no instance was any trouble encountered from the double-acting principle itself, nor is there any reason for expecting it. When a firm has a good single-acting Diesel engine, it can quite well go ahead with the double-acting type. Quite probably there will in each case be room for improvement of the mechanical details, because it is almost exceptional in any class of engineering to get every detail of a new design right at the first attempt.

So far as the new Burmeister & Wain engines are concerned, we are thoroughly convinced that there will be nothing experimental about them. We well remember the same firm building an eight-cylinder 400 b.h.p. engine to try out details of reversing before the Selandia engines were put through the shops. In the same way they have now been trying out a single cylinder double-acting engine of 1,000 b.h.p. to enable them to work out the details for the Swedish-American liner's engines. Burmeister & Wain never left any detail of design to chance.

The comment that has been broadcasted about special steels for these engines and higher pressures, etc., is all poppycock. The stresses in the double-acting type of engine are no higher than in the single-acting type. From an economic viewpoint the double-acting type is superior because it gives a better utilization of the metal used in the engine, and therefore permits the weight to be kept down.

Double-Acting Diesels of Old Freighter

The Real Status of the Case

THE present owners of the German-built motorship ASSYRIA, ex-FRITZ, operated by the Ellerman Line, are having her Blohm & Voss double-acting Diesel-engines removed and replaced by Cooper and Greig steam machinery. Since this vessel was taken over by the British under the treaty terms she has been operated by a number of British companies, but none has been able to run her successfully. It is our recollection that when she was first taken over by the British the work of overhauling her was placed in the hands of a firm of consulting engineers who had had practically no experience in Diesel-engine construction installation, and she had to turn back to port when a few hundred miles on her first voyage after overhauling.

She should have been left in German hands to permit the development work to be carried on by engineers who had been responsible for the encouraging progress that had already been made, but which was avowedly not sufficient to justify any claim that the machinery was commercially satisfactory. We know the British had suffered heavy shipping losses during the war and had good reason to take all the tonnage they could get out of Germany at the armistice. Yet it is probably true that those who counted the German tonnage for the British Government could view the FRITZ only as so many extra thousand tons deadweight-capacity, and had no perception of the immature character of her machinery.

We were speaking with Mr. Blohm about these double-acting engines about two weeks before the declaration of war in 1914, which definitely terminated the possibility of sea-trials. He did not pretend to think that his firm had reached the first stage of development, but stated only that the engineers had reached a point at which they needed marine trials because the shop trials had accomplished about all that could be expected of land tests.

Whatever good reason the British had for putting the FRITZ under their flag in 1918 has long since disappeared. To-day one can only regret that such a step was ever taken. The British engineering industry probably obtained no benefit thereby which it could not have had in other ways. The only result we can see is that the development of the double-acting engine by Blohm & Voss was set back for more years than those covered merely by the war, and there are probably a lot of disgruntled British engineers cursing the double-acting oil-engine when they should instead be cursing their own conceit for believing they could satisfactorily operate immature machinery.

When we saw the engines turning over in the FRITZ in July, 1914, there was nothing to lead us to believe the job was finished. On the contrary Mr. Blohm and Mr. Frahm, both of Blohm & Voss, discussed with us the later possibility of a demonstration voyage under the flag of the Hamburg-American Line, but were emphatic in their declaration that it should be postponed until the engines had been found capable of giving proper service, which might be a long time ahead. This was already the second pair of engines they had built, and Blohm & Voss would not have hesitated to scrap them and build another pair if the sea trials—which were to have begun in August, 1914—had not proved encouraging.

It would be entirely wrong for American shipowners and engineers to draw any other conclusion from the decision to convert the FRITZ to steam-power than this: the Ellerman Line, which has always been a clever buyer, probably chose the FRITZ because her design was suited for one of their regular routes and they could buy her at a cost which would have been cheap for her hull fittings alone; they could not have failed to know her machinery was experimental and intended from the outset to put steam into her; they will thus have a good steamer for less money than they could have bought one of equal class in the market.

MOTORSHIP

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EIGHT BIG MOTOR-LINERS ORDERED

WHEN in our issue of December, last, we stated that the order of the 12,000 to 14,000 horsepower quadruple-screw Diesel motor-liner by the Union Steamship Company meant that every shipowner will be forced to consider most seriously oil-engine power for vessels of all but the very largest size, we did not think that within three months seven more large Diesel-driven passenger ships would be ordered. Yet, as recorded in our columns since then, this has actually occurred, the latest being a 17,000 tons twin-screw motorship of 13,000 shaft horsepower to be built for the Swedish American Line by Burmeister & Wain. As the machinery is of the four-cycle double-acting type, and as the power is on two shafts, this is an engineering stride of tremendous importance.

Altogether there are now twelve large and high-powered Diesel-driven vessels on order in addition to many other cargo motorships from 1,000 tons up to 12,500 tons d.w.c. and 6,000 i.h.p. These twelve vessels are as follows:

LARGE DIESEL-DRIVEN MOTORSHIPS ON ORDER

Owners	*Type of Ship*	*Tonnage of Ship*	*Shaft Horsepower*	*No. of Screws*	*Speed*	*Make of Engine*	*Type of Engine*
Swedish American Line	Passenger Liner	17,000 gross	13,000	2	17 knots	Burmeister & Wain	4-cycle
Union Steamship Co	Passenger Liner	20,000 gross	14,000	4	17 knots	Fairfield-Sulzer	2-cycle
Axel Broström	Ore Carrier	22,000 d.w.c.	5,000	2	11 knots	Burmeister & Wain	4-cycle
Axel Broström	Ore Carrier	22,000 d.w.c.	5,000	2	11 knots	Burmeister & Wain	4-cycle
Rotterdam Lloyd	Passenger Liner	12,000 gross	7,000	2	15 knots	Schelde-Sulzer	2-cycle
Hamburg-South America Line	Passenger Liner	12,000 gross	6,000	2	13½ knots	Blohm & Voss	4-cycle
North German Lloyd	Passenger Liner	14,000 gross	5,000*	2	12 knots	Vulcan	4-cycle
Elder Dempster Co	Passenger Liner	9,000 gross	5,250	2	12¾ knots	Harland-B. & W.	4-cycle
Standard Oil Co. (Germany)	Tanker	17,000 d.w.c.	5,000	2	11½ knots	Krupp	2-cycle
Standard Oil Co. (Germany)	Tanker	17,000 d.w.c.	5,000	2	11½ knots	Howaldtswerke-Sulzer	2-cycle
Nippon Yusen Kaisha	Passenger-Cargo	10,000 d.w.c.	4,000	.	12 knots	Sulzer	2-cycle
Nippon Yusen Kaisha	Passenger-Cargo	10,000 d.w.c.	4,000	.	12 knots	Burmeister & Wain	4-cycle
		182,000 tons	78,250				

*Reduction gear drive.

Furthermore, Norwegian owners are now completing negotiations for two Diesel-driven passenger liners similar in size to the big vessel for the Swedish-American Line, while the Donaldson Line has just ordered an 8,000 tons gross cattle-boat for the transatlantic trade, and Dan Broström may soon order a liner.

A study of this table offers a very excellent answer to the controversy which has been continuously raging regarding the merits and demerits of both the two-cycle and four-cycle types for high-powered Diesel engines. It shows, as we have continuously maintained, that there is a field for both engines in high powers and that each design will find a certain favor with the individual owners.

THE ROTTERDAM-LLOYD MOTOR LINER

REFERRING to the new Diesel-driven passenger vessel just ordered by the Rotterdam Lloyd and briefly described in our last issue as having been placed with the Schelde Shipyard of Vlissingen, Holland, the owners will soon have an excellent opportunity for making comparisons of every kind with steam-driven ships of similar type as they have in service two passenger vessels of the same dimensions propelled by steam turbines. Following are the leading dimensions of one of these steamers and of a motorship:—

	T. S. S. "Patria"	*New Motor Liner*
Displacement	14,740 tons	15,000 tons
Dimensions	500'x57'x37'½" (M.D.)	500'x59'x38' (M.D.)
Shaft h.p.	7,000	7,000
Speed	15 knots	15 knots
Machinery	Two Single reduction Parson steam turbines	Two six-cylinder single acting two-stroke Sulzer Diesel engines

At the present time we do not have the weights of the steam machinery, but the Sulzer Diesel engines will each weigh 410 tons, including flywheel, thrust-bearing and shafting, and without the scavenging blowers which will be driven by electric motors deriving their power from an auxiliary Diesel engine. The propeller speed will be about 94 r.p.m. and the engines will be direct connected. Suitable mean-effective pressure and piston speed can be retained at this speed, namely 66 lbs. per square inch and 825' per minute, respectively. These are well below those which have proved entirely satisfactory with Diesel engines of the same power in land practice, as well as under conservative test-bed conditions.

A MISLEADING COMPARISON

IN a recent motorship-versus-steamer comparison article in "Marine Engineering," L. B. Chapman, Professor of Naval Architecture, Lehigh University, took as the subject a twin Diesel and single-screw steam installations of 1,750 shaft h.p. He stated that the machinery lay-outs (not illustrated by him) clearly show that the Diesel machinery occupies slightly more space than the steam plant, although the general impression is that the motorship is superior in this regard. He gives the lengths as 55' and 50', and the weights as 755 tons and 400 tons, respectively. As these figures do not agree with an average of modern actual installations, it would be of interest if Professor Chapman would state if he took for comparison the largest and heaviest Diesel engine on the market, or an average of the leading half-a-dozen Diesel designs which have proven commercially successful.

It is also worth remarking that all his operating figures are based on the assumption of the complete motorship being 20 per cent. higher in cost than the steamer, whereas actually the cost would not be more than 10 to 12 per cent. greater. Evidently he arrives at his figures by assuming the cost of Diesel machinery to be 60 per cent. higher than the steam plant. Consequently, his entire findings are completely out of balance and inaccurate, and should have been given editorial comment upon publication.

There is another point which needs criticism. Professor Chapman has taken a single-screw steamer and compared it with a twin-screw motorship. Why not compare this steamship with a single-screw motorship, because there at least seven American Diesel marine-engines of 1,750 shaft h.p. or over actually completed today.

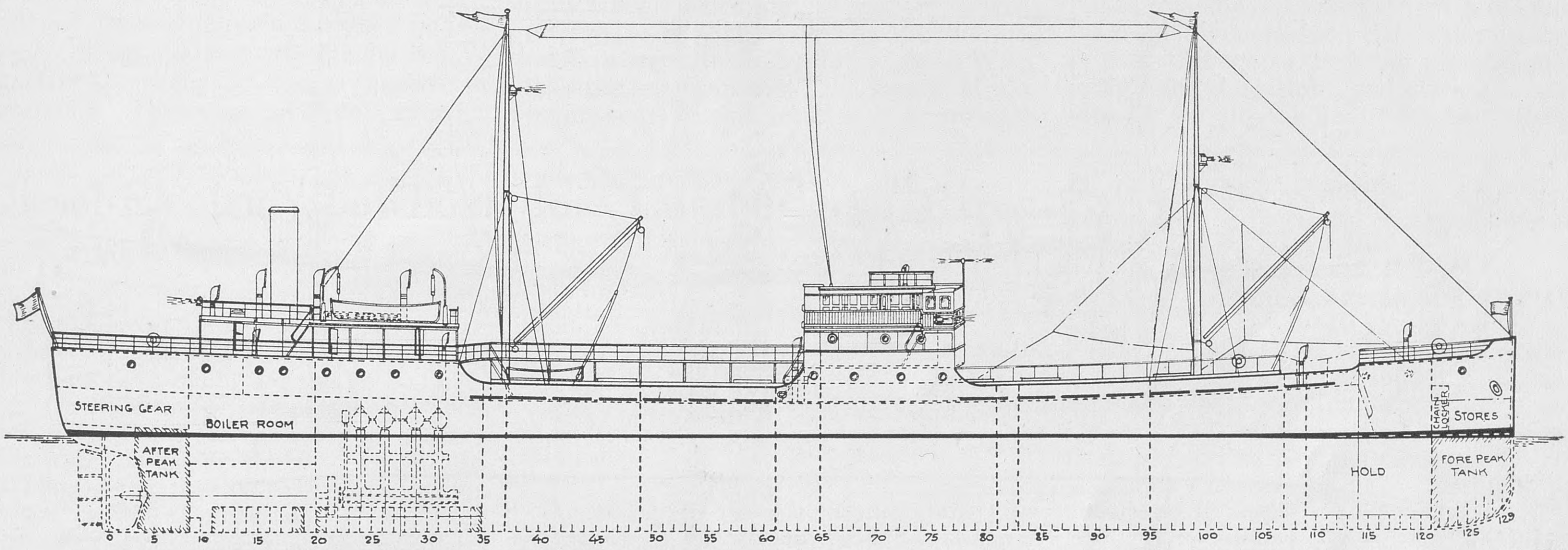
A CONSULTING ENGINEER'S VIEWS

IF they were not apt to be taken seriously by some shipowners, one could find considerable amusement from the remarks made recently by R. J. Eyres, a British consulting-engineer, before the North East Coast Institution of Engineers and Shipbuilders, early in February last. Engineering thought overseas naturally has a certain amount of influence on technical decisions in this country, and vice versa. Therefore, we think some comments should be made on Mr. Eyres' remarks. Incidentally, the latter will serve the purpose of explaining how some consulting-engineers and naval-architects retard the natural growth of economical drive,

partly through blind prejudice or through "playing ultra safe" in their recommendations to shipowners.

Mr. Eyres said that he spoke for himself alone, and was expressing only a personal opinion. "He was bound to say, and, quite candidly, if a trade shipowner said, 'Shall I fit an oil-driven engine?' he would reply, 'No, emphatically, no!' It was reasonable that he should give grounds why he took that attitude. First cost played a very large part. What one was faced with as a consulting-engineer was the choice of engine. He did not think the time had arrived for putting the internal-combustion engine into the ordinary tramp vessel. He had known of breakdown at sea, but, he was told, the internal-combustion engine did not break down at sea. He was delighted to hear that, but, at the same time, the consulting-engineer had got to be an optimistic man, but it was no use going to the shipowner with that unless the optimism was backed by a sure starter and a dead certain winner." In other words, the owner came back to the point: Is this engine going to pay? He was convinced the internal-combustion engine had come to stay and no doubt it would come in time to the tramp steamer, but he still thought he was justified in saying that the time had not yet arrived.

When one takes into consideration that there are actually in service over 800 motorships from 200 to 6,500 i.h.p., many of them tramps, and that there are now under construction, among other motor-vessels, ten Diesel-engined craft of 5,000 to 13,000 shaft h.p. including six transatlantic passenger liners, it would seem that Mr. Eyres has been slumbering for nearly a decade and evidently is not in complete touch with present day development in progress.



The motor-tanker building at the Gotaverken for Nobel interests, and which will be fitted with the new Nobel two-cycle 1,600 h.p. Diesel engine

Recent Contracts for Motorships at the Göta Shipyard

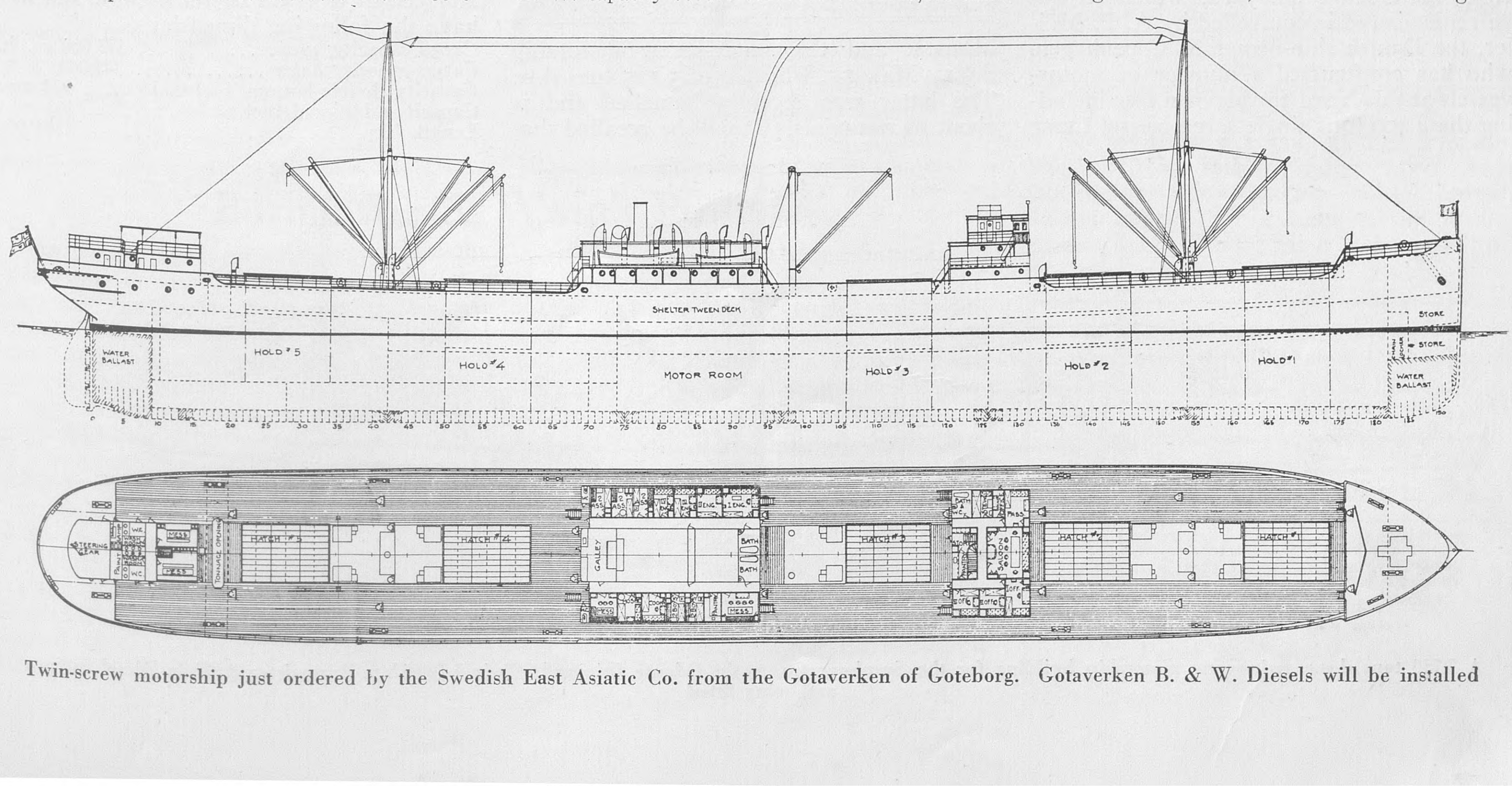
One Vessel to Have Götaverken-Burmeister & Wain Twin Diesel Engines, the Other to Be Propelled by a Nobel-Diesel Single-Screw Engine

WHILE steam shipbuilding in general is very quiet in Scandinavian countries, motorship orders are being placed fairly regularly. A few weeks ago The Swedish East-Asiatic Company, of which the manager and owner is Dan Broström, placed an order with the Götaverken of Göteborg for a motor-liner of 9,500 tons d.w. She will have the following dimensions:

Length b. p.	425'0"
Breadth b. p.	56'0"
Depth m. d. to main deck	30'8"
Depth m. d. to shelter deck	38'9"
Draft	26'5"
Power	4,000 h. p.
D. W. capacity	9,500 tons

This ship is to be equipped with twin 2,000 h.p. Götaverken-B. & W. Diesel engines, and all the auxiliaries in the engine-room as well as the deck machinery will be electrically driven. A service speed of about 12 knots loaded is anticipated, and the vessel should be ready in about 12 months.

It is interesting to record that the various shipping lines controlled by Dan Broström have eight motorships in service on different high-seas routes, all of which have given



Twin-screw motorship just ordered by the Swedish East Asiatic Co. from the Gotaverken of Goteborg. Gotaverken B. & W. Diesels will be installed

complete satisfaction and are superior in every way to the steam-vessels operated by the same lines.

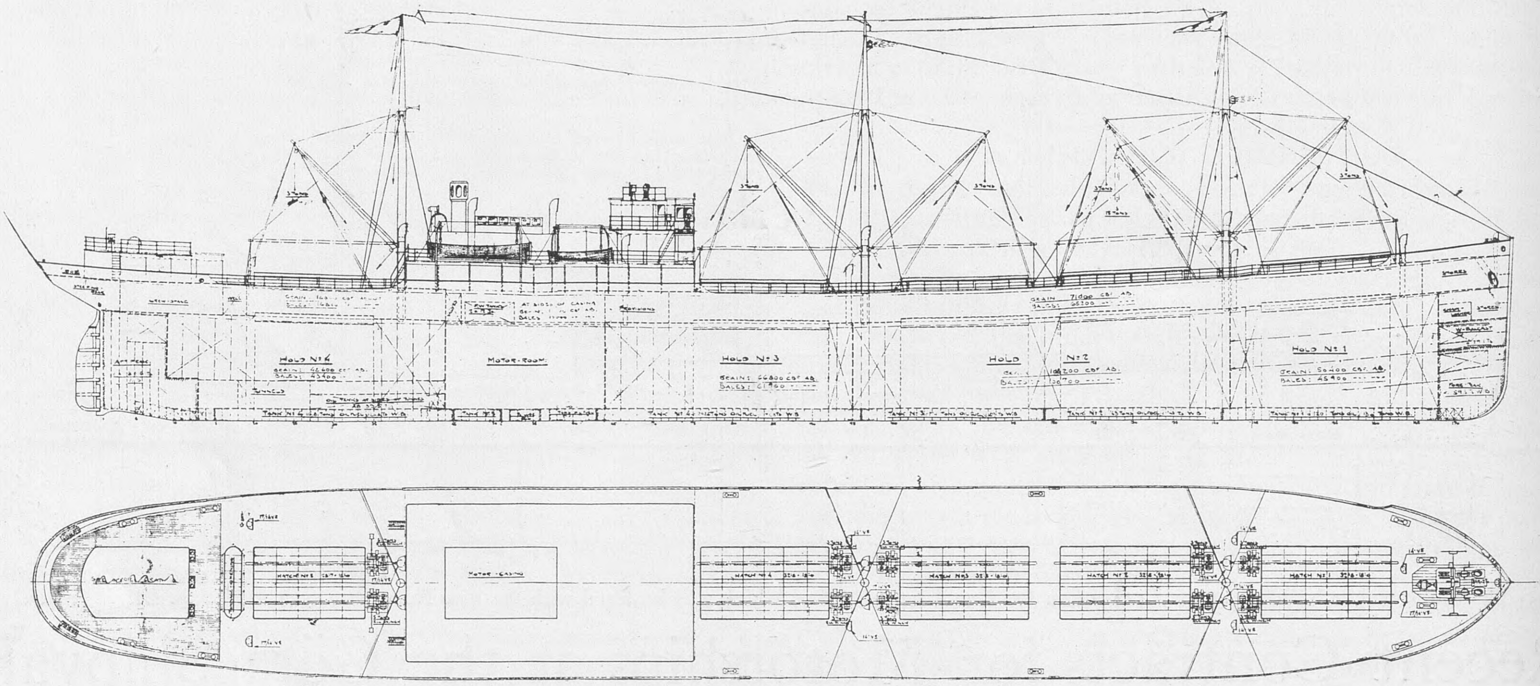
The second vessel recently ordered from Götaverken is the 5,100 tons d.w. tanker ordered by Nobel Bros., in which will be installed the first of the 1,600 h.p. at 105 r.p.m. Nobel-Diesel engines. This engine was illustrated and described in MOTORSHIP of December, 1921. It will be remembered that we were enabled to give the first information to the shipping world that Ludwig Nobel had built a new merchant-marine type Diesel engine, following the closing of his plant at Petrograd by the Soviets.

This tanker has the following dimensions:

Length b. p.	312′0″
Breadth m. d.	49′0″
Depth m. d. to main deck	28′0′
Draft	22′9″
Power	1,600 h. p.
D. W. capacity	5,100 tons

In the case of this vessel, however, the deck machinery will be steam-driven, steam also being used for heating and cleaning the tanks. Because of the several novel features incorporated in the design of this Nobel engine, this vessel is expected to create considerable interest.

Now under construction at the engine-shops of the Götaverken is a 1,600 h.p. long stroke type Burmeister & Wain Diesel engine, which will be installed in a 6,000 tons cargo motorship now under construction in Norway. Similar engines were installed by Götaverken in the single-screw motorships SULINA and ERLAND, which have been running for a considerable time with every satisfaction and with a notably low fuel-consumption.



Inboard profile plan of 6,000 tons d.w.c. motorship recently ordered by the Avenir S. S. Co. of Kristiania, from the Odense Shipyard, in which twin 1,100 i.h.p. Burmeister & Wain Diesel engines will be installed

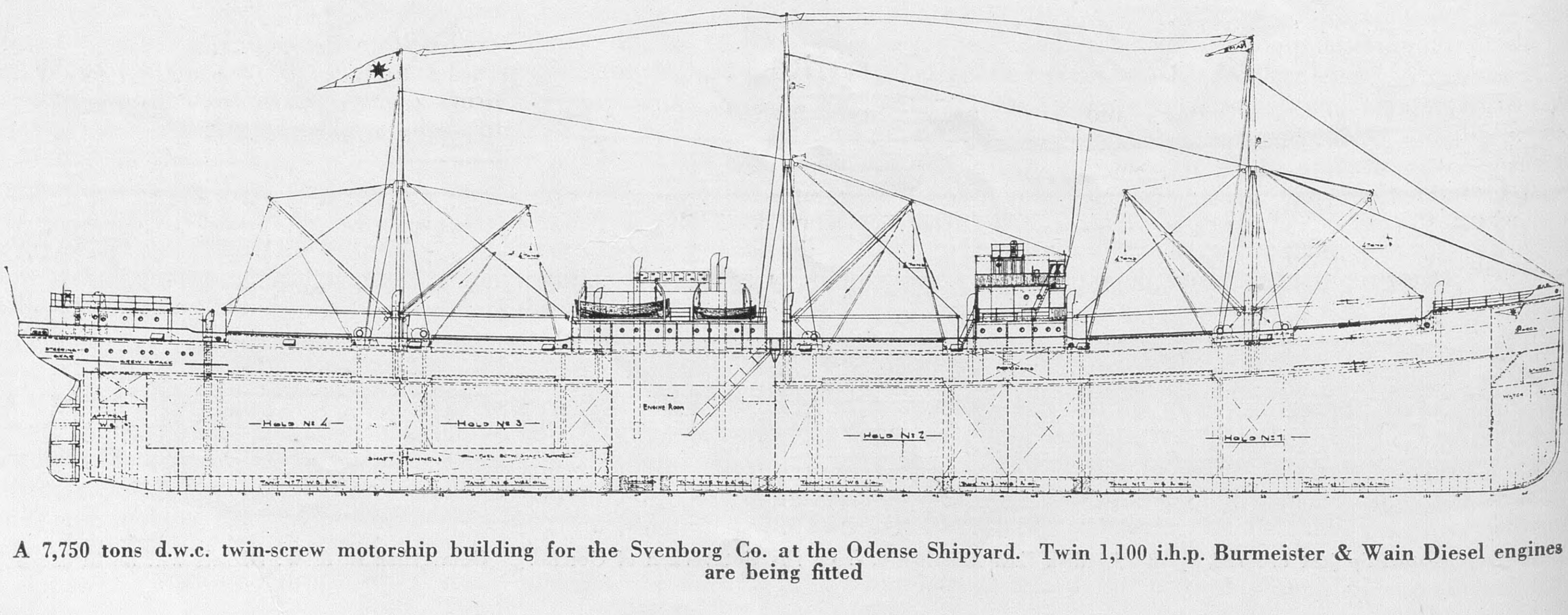
New Motorship for Avenir Company

6,000 Tons D.W. Twin-Screw Freighter, Building at Odense Shipyard, in Which Burmeister & Wain Engines Are Being Installed

ANOTHER Norwegian ship-owning company has adopted the oil-engine motorship, namely, the Avenir Steamship Company, of Christiania, who in January last ordered a twin-screw vessel from the Odense shipyard, which it will be remembered is controlled by A. P. Möller, the Danish ship-owner of Copenhagen, who has constructed a number of motor-vessels at this Yard for his own use, including the 4,400 tons single-screw vessel LEISE MAERSK and the single-screw motorship SALLY MAERSK, which is of 5,125 tons d.w. The latter was recently launched and is about to run trials. It will be recalled that when the LEISE MAERSK came to New York we published a story on her operation.

The motorship for the Avenir Steamship Company is to be a 6,000 tons twin-screw craft, to be propelled by two 1,100 i.h.p. Burmeister & Wain Diesel engines, and will have the following dimensions:

Cargo capacity, *grain*	375,000 cu. ft.
Cargo capacity *bales*	343,000 " "
Capacity double-bottom fuel-tanks	924 tons
Capacity additional fuel tanks	65 "
Length b. p.	360′0″



A 7,750 tons d.w.c. twin-screw motorship building for the Svenborg Co. at the Odense Shipyard. Twin 1,100 i.h.p. Burmeister & Wain Diesel engines are being fitted

Breadth m. d.	50'9"
Depth m. d. to shelter deck	31'11"
Depth m. d. to main deck	23'11"

The vessel will be built to the Norwegian Veritas classifications, and her propelling unit will be two six-cylinder four-stroke type B & W Diesel engines, together developing 2,200 i.h.p. at 150 r.p.m. This installation is of particular interest because these engines are the largest of a special type without crossheads produced by this company, and are of the direct reversible trunk-piston class with forced-feed lubrication, each cylinder having a bore of 500 mm. and 900 mm. stroke, and will be direct-connected to the propeller shafts. A speed of 10¾ knots is expected.

Also in the engine-room there will be two single-cylinder, and one two-cylinder B & W auxiliary Diesel engines direct-connected to generators. These engines have a cylinder diameter of 310 mm. and a piston stroke of 315 mm.

All the engine-room and deck machinery will be electrically-driven, there being eight 3-ton winches and two 5-ton winches of the Thrige make (Denmark). There is also an electrically-driven windlass and Brown hydro-electric steering gear.

We are also able to give plans of one of two 7,500 tons d.w. motorships built for the Svendborg Company at the same shipyard, in which twin 1,100 i.h.p. B & W Diesel engines are being installed amidships. This vessel has been laid down on the ways vacated by the SALLY MAERSK.

Regarding the Ocean Steamship Company's single-screw motor freighter MEDON, referred to on page 200 of our March issue, we have been advised by Burmeister & Wain that the manoeuvering air supply in the engine-room of this vessel is in accordance with their latest design. The compressor attached to each auxiliary engine is of such a capacity and of a new patented design that it can deliver a surplus of air for maneuvering purposes of the main engine. Under ordinary working conditions this compressor will only deliver the injection air necessary for the auxiliary engines, but when manoeuvering-air is required for the main engines the compressor is easily changed to deliver the necessary additional air for manoeuvering by means of a simple controlling device. At the same time the compressor acts as a reserve for the compressors on the main engines. With this arrangement the engine-room installation is simplified, the weight is reduced and the reliability increased. Salt-water cooling is used throughout both for the cylinder jackets and the pistons, and there is no device for varying the lift of the fuel valves.

Diesel-Electric Towboat for Cumberland River

New 80 Ft. Shallow-Draft Vessel with Surface-Ignition Oil-Engines for U. S. War Department

In our issue of December last plans were published of a Winton Diesel electric sternwheel towboat building for the U. S. Engineers Office of the War Department. Bids were opened on March 6th for another stern-wheel oil-engine electric towboat—an 80 footer—for the War Department for service on the Cumberland river below Nashville, Tenn. The following proposals were received:

The vessel which has to make a 15-day trial run, is of steel construction, and has the following dimensions:

Length over all	98 feet 4 inches
Length, moulded	80 feet
Breadth, moulded	20 feet
Depth, moulded	4 feet 6 inches
Crown	3½ feet in 10 feet
Draft, loaded, with full supply of fuel, water, supplies, and equipment	About 2 feet 6 inches
Sheer, forward	1 foot 6 inches
Sheer, aft	6 inches
Power	165 b.h.p.

According to the specifications, the oil-engine is to be of the two-cycle, heavy-duty Semi-Diesel type (we presume surface ignition type is meant) capable of using fuel-oils of 44 to 24 degrees Beaumé and must not exceed a consumption of 0.55 lb. per b.h.p. hour at full load, 0.63 lb. at ¾ load and 0.73 lb. at half-load.

ABSTRACT OF PROPOSALS FOR CONSTRUCTION AND DELIVERY OF ONE EIGHTY-FOOT "SEMI-DIESEL" ELECTRIC TOWBOAT, AS OPENED MARCH 6, 1923, BY MAJOR HAROLD C. FISKE, CORPS OF ENGINEERS, NASHVILLE, TENN.

No. Bidder		Price	Remarks
1.—Penn Bridge Co., Beaver Falls, Pa.	As above	$114,000.00	Detailed information relative to type of machinery and equipment not furnished.
2.—Chas. Ward Engineering Works, Charleston, W. Va.	Anderson 165 h.p. engine.	73,950.00	These 4 propositions are with Westinghouse electrical equipment. If General Electric Co.'s installation preferred, add $800 to each proposal.
	Fairbanks-Morse 165 h.p. engine	75,120.00	
	Fairbanks-Morse 200 h.p. engine	77,400.00	
	Kahlenberg 180 h.p. eng.	77,140.00	
3.—Warren C. Graham Co., New Orleans, La.	150 h.p. Western full Diesel engine	56,512.00	
4.—Howard Ship Yards & Dock Co., Jeffersonville, Ind.	Fairbanks-Morse Y 200 h.p. engine	76,562.00	Equipment No. 1, with Westinghouse equip.
	Fairbanks-Morse Y 200(?)	75,437.00	Equipment No. 2, with Gen. Elec. equip. Either equipment with 150 h.p. Y engine, deduct $2,000.
5.—Nashville Bridge Co., Nashville, Tenn.	Anderson 165 h.p. engine.	71,400.00	Westinghouse electrical equipment. If a 200 h.p. type Y Fairbanks-Morse engine is substituted for the Anderson Foundry & Mach. Co.'s engine, add $3,000 to proposal. If a 200 h.p. type C Taylor principal stationary engine, manufactured by Taylor Machine Co., is substituted, add $9,350 to proposal.

Burmeister & Wain's Profits

The pioneers in large Diesel motor—and Motorship building, Burmeister & Wain, Ltd., of Copenhagen, have recently issued their report for the past year. Taking into consideration the exceedingly bad times for the ship building industry, these show a very favorable position. The balance-sheet shows a net revenue of 1,843,521 Kr., to which must be added the balance from the preceding financial year, 101,365 Kr. The coming general meeting will be asked to use the surplus as follows: 1,000,000 Kr., to the reserve fund, 100,000 Kr. to the workmen's pension fund, 10 per cent. in dividend and a further 5 per cent. bonus to shareholders. The balance of the revenue, after deducting directors' fees, will be carried over to next year's account to meet taxation, etc.

Burmeister & Wain's engine works and ship-yards are an undertaking of national importance for Denmark, and it is therefore, very encouraging to notice this good financial result. The prospects for the future are good. The shipyard is very well occupied with work, and the Engine Works have a lot of orders for the construction of engines to be supplied to high-class Diesel motorships in course of construction in German, British and other foreign shipyards. It is also of interest to note that during last year 26 large motorships were built and engined with the Burmeister & Wain type Diesel motor, making a total of 106 large motorships fitted with this design of oil engine in successful operation all over the world at the end of 1922.

VICKERS TO BUILD BIG MOTOR CATTLE BOAT

The Donaldson Line has ordered a single-screw, 8,000 tons, 3,000 shaft h.p., Diesel-engined, cattle-carrying motorship from Vickers, Ltd. of Barrow-in-Furness, England, for service between Glasgow, Liverpool and Canadian ports. She will be about 400 ft. long.

NORWEGIANS TO BUILD BIG MOTOR LINERS

Negotiations are now being made by Norwegian shipowners for two motor passenger-liners, similar in tonnage and power to the big Diesel-driven vessel just ordered by the Swedish American Line.

NIPPON YUSEN KAISHA ORDER TWO MOTOR LINERS

Lithgow's shipyard at Port Glasgow has received an order from the Nippon Yusen Kaisha for one 10,000 tons d.w.c. twin-screw combination cargo-passenger motor liners of 4,000 shaft horsepower and 12 knots speed. Harland & Wolff have secured the order for a sister motorship of 436 ft. length and 57 ft. breadth. One of the vessels will have Sulzer two-cycle Diesel engines and the other Burmeister & Wain four-cycle Diesel engines.

BRITISH MOTORSHIP WITH DOUBLE-ACTING ENGINES

Barclay Curle are now building a motorship for the three-cylinder, 2,000 shaft horsepower double-acting North British Diesel engines for a London shipowning firm. Each cylinder has a bore of 24½ in. by 44 in. stroke.

Are Steam-Engines Obsolete in Coastwise Shipping?

Freighters, Tugs, Passenger and Other Craft Discard Steam for the Oil-Engine---A Resumé of the Present Situation

REVOLUTIONARY changes are taking place in our coastwise fleet of all types—changes so striking and far-reaching that shipowners are forced to consider them. We refer to the steady and persistent advance of the oil-engine into the engine-rooms of every type of vessel in use on our coast and in our harbors. Nothing can stem the tide of progress as installation after installation proves the wisdom of the pioneers in discarding their steam-engines and wasteful boilers in favor of oil-engine power. "Doubting Thomases" who at first were skeptical have been forced to amend their views with the result that at present there is practically no opposition to the increased adoption of this newer power except from steam-engine interests and from a few dyed-in-the-wool steamship operators.

In these days of keen competition and none too plentiful cargoes the item of fuel cost, the largest single unit of expense at all times, looms larger and larger in the eyes of the shipowner and he is becoming increasingly willing to consider the evidence which the advocates of oil engine power present. Not only are they considering this power, but they are INSTALLING it. The list of installations which we published on page 177 of our March issue bears witness to the fact that American shipowners are at last adopting Diesel power. Twenty-eight vessels totaling 131,175 tons deadweight and 42,400 shaft h.p. are listed, and only six of these vessels are government or municipal boats.

One of the most spectacular instances of the success of Diesel power in competition with steam is found in the purchase by the Pacific Steamship Co. (Admiral Line) of Seattle of the fleet of wooden motorships of the Ocean Motorship Co. of San Francisco. The large steel steamships of the former company have been unable to withstand the pressure of competition by the more economical motorships in the coastwise runs which have been described in MOTORSHIP, notably, in the issue of March, 1922. This fleet consists of the BOOBYALLA, CETHANA, CHALLAMBRA and CULBURRA, all propelled by McIntosh & Seymour Diesel-engines. Their operation has proved the utter fallacy of the contention that motorships are not profitable on short runs.

An important shipping man of Seattle, in discussing this matter with a representative of MOTORSHIP admitted that the situation had reached a point where the entire policies of coastwise companies must be re-shaped to meet existing conditions brought about by the competition of motorships. He prophesies a sharp division of coastwise business, with the passenger trade handled by fast steamers of the type of the H. F. ALEXANDER, which affords a service equal to the train time between Seattle and San Francisco, while the freight service will be provided by motorships of fair speed. We are willing to go still farther and prophesy that the passenger service will be handled by *motorships*, as well.

Puget Sound passenger and freight business was formerly served by moderate size steamers especially designed for the large volume of trade along the busy shores of this great inland sea; motorships have now practically driven them from these waters. In fact, the only run which is now considered profitable for a steam-propelled vessel is that between Seattle and the Bremerton Navy Yard, this being a fast commuting service. However, this is now threatened by a Diesel-ferry designed for passengers, freight and automobiles.

Among the fleets operating on the Sound is that of the Merchants Transportation Co. of Tacoma, Wash., which serves all ports on its shores. These vessels were originally propelled by steam, but are now equipped throughout with Fairbanks Morse oil-engines and so efficient has this fleet been that F. H. Marvin, vice-president of the company announces that they will soon call for bids on a new 300-ton freighter to be propelled by a 150 h.p. oil-engine.

Another important type of vessel on the Pacific coast which is shortly to be *modernized* by the adoption of Diesel-power is the lumber-carrier, quite numerous in number. Several motorships of the type of the LASSEN, whose operation was featured in the March, 1922, issue of MOTORSHIP on page 180, have been engaged in carrying lumber, but for years this work has been in the hands of owners of "steam schooners." This trade is now being invaded by the Diesel-engine, and it is safe to predict that the steam-engine will eventually be driven out of this trade. As an entering wedge, the motorship FRANK LYNCH, formerly the U. S. Shipping Board steamer LAKE SUNAPEE, is being placed in this service by the Benson Lumber Co. of San Diego, Cal. She has just had her wasteful steam machinery removed, and one 850 brake h.p. Pacific-Werkspoor Diesel-engine, also purchased from the Shipping Board, has been installed. The resultant saving of three members of the engine-room crew and $77 per day in fuel-cost will undoubtedly mean that this vessel will be able to carry lumber at a rate which *steam* lumber-schooners can never quote and that eventually Diesel-driven vessels will be alone in this trade.

On the Atlantic Coast the recent conversion of the steamer COURTOIS (re-named MUNMOTOR) for the Munson Steamship Line by the Sun Shipbuildidng Corp., Chester, Pa., has been an important step, although the vessel is not large. While no operating data have been available, it is nevertheless certain that she is a success from an economical stand-point compared with her previous operation as a steamer, since this company has also completed the conversion of the steamer COVEDALE, in which a 900 brake h.p. McIntosh & Seymour Diesel-engine has been installed. A similar engine was installed in the MUNMOTOR.

One of the most important orders for new motorships recently placed is that of the U. S. Steel Products Corporation for two 262 ft. single screw 750 h.p. McIntosh & Seymour Diesel-powered steel vessels now under construction by the Federal Shipbuilding Corporation, Kearney, N. J. These new ships will be used on the New York State Barge Canal during the months this waterway is open to navigation and at other periods in coastwise work.

Until the present year the Canadian Pacific Railway system has never operated a Diesel-driven vessel; they are shortly to place in service a new ferry driven by two 600 shaft h.p. McIntosh & Seymour Diesel-engines. She will attain a speed of 14 knots and be placed in service between Bellingham, Wash and Victoria, B. C., handling passenger and automobile traffic. We predict that her performance will lead to a modernizing of the entire fleet of this great transportation company by a complete use of Diesel-power.

In addition to the actual work under way in the shipyards there is "in the air" a great number of proposed conversions contemplated by shipowners. In fact, practically every owner of a fleet of steamers is contemplating converting them to motorships, as they can readily see where the persistent operation of steamships will lead. Some pretend to be indifferent to the advance of this newer type, but they are, nevertheless, gathering information against the day when they *must* adopt the motorship.

Steam-power has met great defeat in the smaller and intermediate sizes of vessel, from which it has nearly disappeared. Literally scores of instances of the installation of oil-engine power in place of steam could be quoted, both in vessels from which the latter power has been removed or in new vessels. The economies which have resulted have been startling and they have been recorded in the pages of MOTORSHIP so often that it would be difficult to name outstanding specific instances. Small steam installations are notoriously wasteful of fuel, depending as they do upon more or less skilled men as firemen, varying pressures due to change of watch, banking fires and quality of coal. In the very nature of the type of power there is a large loss of economy which can never be overcome, *i.e.*, a differential in favor of the Diesel-installation of 26 per cent over-all thermal efficiency, that of the Diesel-engine being 38 per cent as against only 12 per cent for the reciprocating steam plant.

Another great factor militating against the continued use of steam is the expense of fuel while the vessel is laid up with fires banked. The day has passed when shipowners can afford to burn up their dollars and send them up the funnel in smoke.

If the S. S. "New Hampshire" Were Converted to Diesel Power

Operation Costs With Her Existing Steam Power and Probable Operating Costs If She Were Changed to Diesel Drive

HAVING occasion to go to New London recently, we went on the night boat NEW HAMPSHIRE, owned by the New England Steamship Company of New York, and took the opportunity to secure a few notes regarding the fuel-consumption, speed, crew, etc., for the purpose of comparison with Diesel drive and some very interesting approximate figures have resulted.

We find that the saving in fuel, wages and food of crew would amount to the total of $32,545 against which must be offset an annual interest charge of $13,680 on the money invested for the cost of the conversion. Against the latter it is possible that if sufficient freight can be found, the additional cargo or passengers carried would more than absorb the interest charge.

The NEW HAMPSHIRE is a vessel of 2,395 gross tons and is propelled by a four crank triple-expansion steam engine designed with an output of 2,500 indicated h.p. at 104 r.p.m., which gives the vessel a maximum speed of 16½ to 17 knots. However, no indicator cards have been taken during the last few years, but the engine averages 92 revolutions, at which speed about 1,500 i.h.p. is developed, giving her an average speed of 15 knots. Her propeller shaft is 13½" diameter and the propeller is 16' diameter by 18' pitch.

She is an old boat, but three years ago she was fitted with Babcock-Wilcox water-tube boilers. As near as we can roughly measure it by pacing, the main engine and auxiliaries occupy a space of 32', while the boiler-room from the engine-room bulkhead is about 33' or a total of 65' altogether.

The total distance from New York to New London and return is 260 miles. On each round voyage the vessel spends nine hours at sea each way and 10½ hours in port at New London. For this period of 26½ hours she burns about 38 tons of coal, which at $7.00 per ton figures out at about $266.00. In New York the vessel spends about ten hours; but in order to take as near to a 24 hour period as possible we will omit this stop in our comparison, merely including 16 hours at sea and 10½ hours in port at New London.

It would seem that in view of the speed requirements of the schedule carried out by this boat, the installation of a Diesel engine which would normally give 1,500 i.h.p. at 90 r.p.m. and which would be capable of developing 2,000 i.h.p. at 105 r.p.m. for a period of five or six hours whenever necessary would be sufficient power for this boat.

If a four-cylinder, two-cycle engine were installed it would proably go into the existing main engine-room space, with the result that all the space devoted to the boilers could be saved. If a six-cylinder, four-cycle engine were installed it would probably be necessary to move back the engine-room bulkhead another 10'. This would give additional space for cargo, or if there were no cargo it could be used for passenger accommodation as there would be no annoying heat from the engine-room.

We figure that the total cost of the conversion work would be about $228,000, although with some makes of engines it may be as high as $250,000. This charge is divided as follows:

Cost of main engine	$128,000
Cost of installing new auxiliaries and equipment	40,000
Cost of conversional work	60,000
Total	$228,000
Annual interest charge on this investment at 6 per cent	$13,680

If more power is required another $25,000 will have to be added to the cost of the main engine.

Normally this engine would burn 3½ tons of oil per hour at sea, while in port the fuel-consumption would be about one ton in 10½ hours, on the assumption that the steam is only used for heating purposes in the winter time and that the auxiliaries were oil-engine electric. The vessel has three winches serving the forward and aft holds but most of the cargo is wheeled in on trucks from the pier over a special gang-plank. Therefore, very little power would be required for auxiliaries when in port.

Thus, for the 16 hours at sea the fuel bill of the main engine would be $40.37 with fuel-oil at $11.25 per ton, while the consumption of the auxiliaries in 10½ hours in port would cost $11.25, or a total of $51.62 for the 26½ hours. Thus, compared with her present fuel costs there is a saving of $114.38 per 26½ hours. Assuming this is repeated 182 times per year (allowing for the 10½ hours port stop at New York) the total annual saving in fuel will be $20.-817. The controlling factor is, of course, the price of fuel, as there is always the possibility of oil increasing in price and coal costing less.

At present the vessel has 16 men in her engine-room, namely, Chief, First, Second, and Third Engineers, two oilers, two water-tenders, six firemen, and two coal passers. If she were, however, equipped with a single main Diesel engine of the power given she would not require more than seven men as follows: Chief, First, Second and Third Engineers, two motormen, one electrician.

Therefore, to the saving in fuel-consumption we can add the wages of nine men saved, at an average of $90 per month or a total of $972. The saving of their food at 65 cents per day amounts to $2,008, or a total of $11,728. Consequently, the total annual saving would be $32,545.

As we have previously mentioned, it is possible that the additional passenger or cargo capacity will bring in sufficient earnings to offset the interest charge on the cost of conversion. At present the NEW HAMPSHIRE has a capacity for 466 passengers and 110 crew.

Commenting on the article on this page J. Howland Gardner, Vice-President of the New England Steamship Company, does not consider the data regarding the steamer of sufficient accuracy to form the basis of a proper comparison, nor has he such data. Reliable data could be obtained, says Mr. Gardner, only by carefully conducted tests of the machinery over a period of not less than 24 hours in continuous operation at full power, with proper methods to determine the steam consumption of the main engines and auxiliaries. Also a series of progressive speed trials at various propeller revolutions would be necessary. Also, continues Mr. Gardner, we do not feel that at the present time the Diesel engine has entirely demonstrated its fitness for our particular service.

However, we believe that the data as outlined by us will give some idea of the benefits that can be derived from Diesel power in coastwise vessels of this type, although we realize our figures are only approximate.

TADGE MADSEN READS ANOTHER PAPER

At a meeting of the Institute of Marine Engineers in London on Feb. 13, Tadge Madsen, Superintendent Engineer of the Transatlantic Steamship Co., Göteborg, Sweden, read a paper entitled "Internal Combustion and Economy." In the course of his remarks we note the following on the subject of motorship fuels.

"If an oil-fired steamer has the chance to touch a cheap oil harbor, she is almost able to beat a similar motorship which is making a voyage on 80s. ($18.80) Diesel oil. This may be one reason why shipping companies in cheap oil harbors are not so particularly interested in the internal combustion engine. If, however, a motorship can bunker the same oil, the expenditure in the engine room drops to 2.75 pence (5½ cents), for carrying 1,000 tons one mile, which is encouraging. In addition, the motorship in this case makes three voyages of the duration when the steamer will have to re-bunker. The motorship has thus a good chance to reach a cheap bunker place later on.

"With the 60s. ($14.10) and 80s. ($18.80) prices here in England for the lower and higher grade of oil fuel, the cost per mile with 1,000 tons, including engine-room staff and lubricating oil works out as follows: For the steamer, 9.5d. (19c.); low-grade-oil engine, 4.1d. (8¼c.); high-grade-oil engine, 5.1d. (10¼c.). A ship of this kind with oil engine burns roughly 2,000 tons a year, and by using the lower grade about £2,000 ($9,500) will be saved a year, which certainly makes up for extra wear, if the oil is not bad.

Kelp Harvester Becomes Motor-Freighter

From kelp-gathering to ferry service, thence reconstructed for freight service, is the history of the F. H. MARVIN, ex-HARVESTER KING. After several years' service in the first-named industry she was brought to Seattle, Wash., and operated by Capt. Harry Crosby and associates as a ferry between Anacortes, Wash., and Vancouver Island, B. C. She is 121'-0" length, 32'0" breadth and 8'-5" draft.

She has been purchased by the Merchants Transportation Co., of Tacoma, Wash., and reconstructed at an expense of about $25,000 by the Western Boat Building Co., Harbor Island, Tacoma and equipped with an additional 100 h.p. Fairbanks Morse oil-engine. She was formerly propelled by one 100 h.p. engine of this make, which has now been moved outboard and a similar engine installed to provide a twin-screw plant which will drive her at 8 knots. Her name has been changed from HARVESTER KING to F. H. MARVIN, in honor of the vice-president of the Merchants Transportation Co., whose fleet now consists, in addition to the subject of our article, of the A. W. STERRETT, with two 75 h.p. Fairbanks Morse oil-engines, the T. W. LAKE with two 45 h.p. and the V. P. HANDY, with one 45 h.p. Fairbanks Morse oil-engine.

When reconstructing this kelp-gatherer, in addition to making her twin-screw drive, a seven-ton freight-elevator, several ten-ton cargo-booms, three watertight bulkheads, two-berth rooms for the crew and steam-heat were provided. The result is one of the best freight-carriers on the waters of Puget Sound.

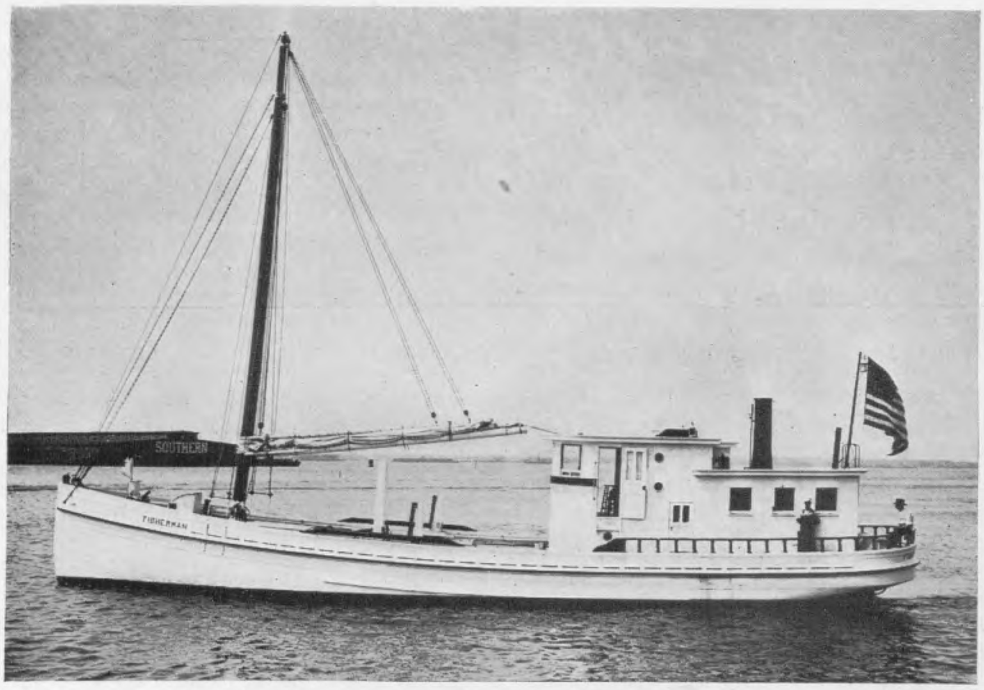
Motor-freighter "F. H. Marvin"—ex-"Harvester King"

Successful Oyster Dredger

Along the shores of Virginia, Delaware, New Jersey, and Maryland, and on the Gulf Coast are to be found a considerable number of boats engaged in gathering oysters from the extensive "beds" which abound in those waters. These beds are in shoal water in which the dredgers operate by dragging big rakes over the oysters, thus gathering large quantities at a time. There are several hundred of these craft ranging in size from 35' to 75', equipped with engines from 30 to 200 h.p. Among them may be noted as typical of the oyster-dredger the FISHERMAN, owned by J. H. Miles Co., of Norfolk, Va.

This boat is 75' long, 24' breadth and 5' draft and is equipped with a four-cylinder Fairbanks Morse oil-engine, which is installed aft of amidships directly under the pilot-house, to which controls are led. Aft are quarters for the crew, while the forward deck and hold are clear for oyster cargo and the dredging-gear. A mast provides a sail for assistance in a favorable wind and to steady the boat, while amidships are the bitts and rollers connected with the dredges. She is constructed of wood in a very substantial manner, as these craft operate in shoal waters which often become quite rough under certain conditions.

A three-blade Columbian bronze propeller of 48" diameter and 36" pitch drives at economical speed. She dredges more than a thousand bushels of oysters in under three hours on a consumption of less than four gallons of fuel-oil per hour. The owners state that they "have never had a hot head or a loose tap or a bit of trouble with this engine" during the period it has been in use and that they "know of no power that they would exchange for it." They operate a smaller boat, the OYSTERMAN, which also has a Fairbanks Morse oil-engine, but of 45 h.p.



Fairbanks Morse oil-engined oyster-dredger "Fisherman"

UNIQUE FISHING SCHOONER OIL-ENGINE INSTALLATIONS

Among the American fishing fleet of Boston and Gloucester, Mass., which have been mentioned as competitors in the elimination races held in connection with the annual International Fishermen's Races off Halifax, Nova Scotia and Gloucester, Mass., are three which have now been equipped with oil-engines. They are the L. A. DUNTON, HENRY FORD and YANKEE. In addition to these the fishing schooner MAYFLOWER has been fitted with an oil-engine at the Gorton-Pew Fisheries Co. shop in Gloucester, Mass. This schooner will be remembered as having been especially designed and built to compete in these annual races, but was never allowed to do so. Undoubtedly the installation of auxiliary power in these schooners means their withdrawal from these contests, as their propellers would decrease their speed greatly in a race under sail.

All these schooners have been equipped with a 100 h.p. Fairbanks Morse oil-engine installed in a compartment just forward of the after cabin. As no shaft-log was provided when the vessels were built, these engines are installed with their shafts placed at about nine degrees with the center-line of the vessel. The forward end of the engine is practically over the keel, while the 3½" shaft extends out through the hull so that the three-blade 50" x 32" propeller is on the port side of the boat, supported by a strut having two arms set at right angles. When the schooner is under sail the propeller will revolve with the flow of water past the hull.

On each side of the engine are installed two fuel-tanks, the total capacity being 2,000 gallons. These tanks are constructed of No. 7 gauge (3/16") pure iron, galvanized and tinned and fitted with N. 12 gauge swash-plates. The discharge connections are ¾" diameter.

A 100 h.p. Fairbanks-Morse oil-engine has been installed in the tow-boat STARLING, owned by Capt. N. L. Johnson at the Ballard Marine Railway Co. of Ballard, Wash.

NEW AMERICAN DIESEL-ENGINED LIGHTSHIPS

Two motor lightships are shortly to be constructed by the Department of Commerce, Bureau of Lighthouses, Washington, D. C., and will be propelled by Winton Diesel-engines. The general dimensions of these vessels are as follows:—

Length o.a.	132′ 4″
Length on waterline	109′ 6″
Breadth	30′
Depth	16′
Power	400 shaft h.p.

Both vessels will be single-screw and will be fitted with an eight-cylinder four-cycle type Winton Diesel-engine of the trunk piston model. For auxiliaries in the engine-room there will be one Diesel-driven generating-set of 35 K.W., one Diesel-driven generating-set of 25 K.W. and a kerosene driven generating set of 12 K.W. On deck there will be an electric-driven windlass, one electric boat-hoister, two electric-driven air-compressors for fog signalling, while there will be complete equipment of radio receiving and sending sets, radio fog signal, submarine bell and a compressed-air siren. As yet the make and type of auxiliary oil-engines have not been decided.

OIL ENGINE TRIALS

As many different oil-engines as is possible and practical will be tested by the joint committee formed in Great Britain by the Institution of Naval Architects & Marine Engineers, and the Society of Mechanical Engineers. So far it has been arranged to run five trials, and Richardsons, Westgarth have offered a hull for the purpose as well as contributed $5,000 towards the expenses. The Chief-Engineer of the British Navy is on the Committee. Incidentally, the Society of Mechanical Engineers has a credit balance of about $335,000 and a membership of 8,734.

MAIDEN VOYAGE OF MOTORSHIP "LOCHGOIL"

LOCHGOIL, sister 12,000 tons d.w. motorship to the LOCHKATRINE and one of three vessels recently built for the Royal Mail Steam Packet Co., all of which are sisters to the motorship DINTELDYK (one of three motorships building for the Holland-America Line), arrived at San Francisco on February 10th on her maiden voyage. This fleet of six vessels maintains a service between the Pacific Coast of the United States and Europe.

Although exceptionally heavy weather has been prevailing in the Atlantic, her run was made without a stop at an average speed of 11.5 knots. Like the other vessels referred to, the LOCHGOIL is a Harland & Wolff production and is propelled by twin 8-cylinder H. & W.-B. & W. Diesel engines together developing 6,200 i.h.p. and is 502′ in length overall by 62′ breadth, her loaded displacement being 19,230 tons. She was launched at Glasgow during August last and on trials preparatory to starting on her maiden voyage she made a speed of 13.2 knots. Her deck machinery, steering-gear and engine-room auxiliaries are electrically operated, while electricity is also used for heating the vessel. Ample refrigerating space is provided for carrying fruit, dairy products and other perishable products, there being five refrigerator spaces between decks, while No. 3 hold is devoted entirely to perishable fruit.

MOTOR VESSELS UNDER CONSTRUCTION IN HOLLAND

In our March issue, page 187, we referred to the fact that last year there were built in Holland 272 motor-vessels of 100 h.p. and under, as well as 11 larger Diesel installations totaling 12,130 h.p., the total tonnage of both classes of motorships being 33,295 gross tons. In addition to these vessels there were under construction in Holland on January 1st, 1923, a total of 93 vessels comprising as follows:

Motorship INDRA, 6,500 tons, for Winge & Co., of Christiania, in which two 1,400 i.h.p. Werkspoor Diesel engines are being installed.

Two oil-engined auxiliary schooners of 960 tons.

Fifty-eight oil-engined barges.

Seventeen oil-engined motor tugs.

One motor lifeboat.

Two motor fishing boats.

One 80′ Government vessel.

One 426 tons lightship, named MAAS, building at Schuyts Shipyard, in which a 120 b.h.p. Atlas-Polar Diesel-electric installation is being made.

Since then, as recounted in our last issue, a 14,000 tons motor passenger-liner has been ordered, in which twin Schelde-Sulzer Diesel engines of 3,500 shaft h.p. are being installed. Furthermore, there are a number of Diesel-engined submarines now under construction in Holland, details of which are given elsewhere.

DUTCH SUBMARINES NOW BUILDING

The following submarines are now under construction in Holland:

Class	*Tonnage*	*Power*	*Make of Engine*
K–9	...	1,600 b.h.p.	Schelde-Sulzer
K–10	...	1,600 b.h.p.	Schelde-Sulzer
K–11	...	1,200 b.h.p.	M. A. N.
K–12	...	1,200 b.h.p.	M. A. N.
K–13	...	1,200 b.h.p.	M. A. N.
O– 9	650	900 b.h.p.	Schelde-Sulzer
O–10	650	900 b.h.p.	Werkspoor
O–11	650	900 b.h.p.	Sulzer

ATLAS PURCHASE ACME

For the purpose of manufacturing small sized Diesel engines, the Atlas-Imperial Engine Company have taken over the entire plant, tools and equipment of the Acme Engine Co.

ORE S.S. CO. TO HAVE OIL-ENGINED TUG

Plans for a 84′ Diesel-driven tug for New York barge canal service have been prepared by the Ore Steamship Co., of New York, but the vessel may not be built until next season.

J. S. JONES MADE VICE-PRESIDENT OF CHAS. CORY & SONS

At the February meeting of the Directors of Charles Cory & Sons, Inc., Varick street, New York City, Joseph Stansbury Jones was elected vice-president. Previously Mr. Jones was assistant to W. S. Doran, president. It was in 1919 that Mr. Jones resigned from the Navy Department, where he was Senior Electrical Expert Aide at the New York yard, in order to become associated with the Cory Corporation. His many years of varied experience with engineering problems pertaining to the navy and merchant-marine makes him particularly fitted for his new position. The House of Cory is well known in the marine field, having been established in 1845, since when they have secured a very fine reputation.

PRACTICAL UTILIZATION OF THE DE LAVAL PURIFIER

In the Diesel-electric ferry GOLDEN GATE, propelled by Werkspoor Diesel engines and General Electric generators and motors, the lubricating service pump is of the rotary type, consisting of two pumps driven by each main engine. One pump supplies pressure to the force-feed system, while the other provides for the discharge from the crank case back to the lubricating-oil tank. In the latter the oil is kept free from impurities by means of a De Laval electrically-driven oil purifier, with the result that it should never be necessary to take any oil out of the system. The estimated consumption is two gallons of lubricating oil for 8 hours of operation (this is for the two 525 s.h.p. engines), and represents no more than that part of the oil which decomposes in service or leaks out of the system.

IGNITION PLUGS FOR SURFACE-IGNITION OIL-ENGINES

While blow-torches and hot-bulbs for starting surface-ignition oil-engines have been largely superseded by the electric plug they are still in use by some firms in Europe. To heat a blow-torch for starting needs from 10 to 15 minutes, whereas the electric plug requires but a fraction of that time. In Sweden there has been developed a quick-starting plug called the "Mox," which, among others, has been applied to the Skandia oil-engine.

No electric current is required as the device consists of a tablet of a similar composition to thermit, used in welding. This is composed of ferro-oxide and aluminum, which, when ignited, forms aluminum-oxide and iron, a temperature of approximately 5,400 degrees F. being reached during the process of burning. These "Mox" tablets are cylindrical, 1¼″ in diameter and ⅜″ thick, with a hole in the center into which a "storm match" is placed. One is laid in the receiving bowl of the ignition-plug, and after igniting the tablet the cover is closed; the resultant intense heat is immediately transferred by the plug to the oil-vapor in the cylinder, producing ignition and compression of same.

The plug, which is of any convenient shape, to suit the engine, is made of copper. "Mox" tablets have also been used in soldering-irons and for cooking. The Bolinders Co. have also tried them, but no definite data is available on the results of such use. From the fact that this latter company has recently equipped their engines with an electric-plug it is to be inferred that the latter are considered with greater favor.

CURRENT REVIEWS

Krupp High-Speed Diesel-Engine, distributed by the American Krupp System Diesel Engine Company of New York, and published in Germany. We have received an interesting catalogue dealing with the high-speed type Diesel-engine manufactured by Krupps at their Kiel Gaarden Plant. A number of these engines are of the submarine type, which have had their ratings reduced, minor changes made and converted for commercial uses, such as yacht engines and for stationary power plants. Quite a number of these engines have been installed in power plants on land for municipal lighting and other purposes.

Detrimental Effects of Sulphurous Fuel on Air-Compressors

Second of the Practical Articles by A. B. Newell, Who for 30 Months Was Chief Engineer of the MS. "Bramell Point"

THE destructive action of sulphurous fuel on certain parts of the Diesel engine is often greatly exaggerated while those parts in real danger are completely overlooked. Sulphur seems to have gotten a bad name at one time, and ever since it has suffered many an unjust accusation, while in the meantime it slyly carried on its destructive action, striking at a spot and in a manner least suspected.

Excessive sulphur does not damage an engine while it is running. It is only after the motor has been shut down and allowed to cool that damage is done. However, the air-compressor may be completely put out of commission, while in operation, as the result of the motor burning sulphurous fuel.

The hydrogen in fuel-oil burns to H_2O, which under normal running temperatures is expelled with the exhaust-gases in the form of superheated steam. The sulphur in the fuel burns to SO_2, which under normal running temperatures passes out of the motor in the form of an inert gas. This gas, even when condensed, is inactive as far as iron and steel is concerned, if anhydrous (i.e. destitute of water). Evidence of this is that anhydrous sulphurous acid is shipped in steel containers.

When the engine is shut down and allowed to cool, the H_2O present in the gases forms small drops of water on the cylinder walls and heads, exhaust valves and inside of the exhaust manifold. Commonly this is called sweating. These drops of water rapidly absorb the SO_2 gases present, and this forms a dilute sulphurous acid, which is very active on cast iron and steel and causes excessive pitting.

If, before the engine is shut down, it be purged of sulphur gas by running on a non-sulphurous fuel for a few minutes, there need be no worry over this pitting. In the case of a forced shutdown, in which the change can not be made to a non-sulphurous fuel, it is advisable to turn the motor a few revolutions by means of compressed air and thus blow practically all of the sulphur fumes out of the motor.

From the foregoing statements it can be readily seen that, with motors which are running almost continuously, there is little danger attaching to the use of sulphurous fuel, in as far as the working-cylinders, pistons, rings, exhaust valves, etc., are concerned.

When the motors are burning sulphurous fuel it is almost impossible to keep the engine-room clear of SO_2 gases for the best of exhaust pipes and expansion joints will leak slightly. Even though this gas be so weak that it will not be offensive to the men working in it, it will be strong enough to completely ruin a compressor breathing it.

The compressor is constantly breathing in moist air, which is heated by the act of compression. When this heated air passes through the intercoolers its temperature is lowered to a point below the dew-point, and a portion of its moisture is dropped. If this air contains a small amount of sulphur gas, the condensate formed in the intercoolers will become dilute sulphurous acid, which I repeat is very active on cast iron and steel.

The rapid passage of air from one stage of the compressor to the next, by way of the intercoolers, will cause a certain amount of this dilute sulphurous acid to find its way to the cylinder walls, pistons and rings, where it will eat the metal away, forming sulphate of iron, which when mixed with the lubricant almost destroys its lubricating properties.

Because the high-pressure cylinder is the most sparingly lubricated it will suffer most and be the first to give trouble. Sometimes at the end of a week of running, after rings and liner have been renewed, the high-pressure rings will be completely destroyed and a disassembly will show that they have disappeared as if by the trick of a conjurer.

The attack upon the low and intermediate cylinders and rings will be much slower, and generally the destruction of the high-pressure parts will put the compressor completely out of commission before these are seriously damaged.

To save the compressor in the presence of sulphur gases it is only necessary to pipe the air inlet breathers to some place outside of the engine-room where the air is clean. This is a most advisable practice, even though there be no sulphur fumes in the engine-room, for the compressor will always give much better service with clean air.

There is a method of overcoming any and all of the difficulties which may arise as the result of burning sulphurous fuel, if its action is thoroughly understood. The presence of sulphur in fuel oils should be the last thing to cause worry to an engineer.

Cammell Lairds & Diesel-Electric Drive

R. S. Johnson, the Managing-Director, Outlines His Views Before the Liverpool Engineering Society

AS Cammell Laird & Co. of Birkenhead, England, are building three Diesel-electric passenger-and-fruit carriers for the United Fruit Lines of Boston, Mass., and as they also build the direct-drive slow-speed type of Fullagar engine the following remarks recently made by R. S. Johnson, managing director of this firm, will have special interest at this time:—

"Whilst turbo-electric drive provides a solution for moderate or high powers, without any loss of economy, as compared with either the single reduction or double reduction geared turbine, the Diesel electric drive in the case of lower powers, opens up the field for far greater running economy and can even compare favorably with the Diesel direct coupled machinery.

"With the present state of development of the Diesel engine for direct drive, it is found that most shipowners prefer to have twin-screw machinery in preference to single-screw, principally, no doubt, because the sizes for the larger powers cannot yet be obtained on a single shaft. By the use of Diesel electric drive it is possible to standardise the smaller high-speed oil engine in units, a combination of which can be made suitable for the power required. The engines can be made of a much simpler form and of lighter construction, whilst by means of the motor the correct propeller speed can be obtained.

"In the Diesel direct-drive the engines are designed with a view to the best compromise for propeller revolutions and are coupled direct to the propeller. Elaborate and complicated reversing gear has to be fitted and the heavy starting torque on the engine has to be provided for in the design, and as the engines are directly connected to the propellers, they have to be made heavy to withstand propeller shocks in bad weather.

"With the Diesel electric-drive the engine can be designed with no reference to the propeller speed, and as the engines run in one direction only and at a constant speed, and are not directly connected to the propeller shafts, it follows that a high-speed engine without any reversing gear can be used. In effect one has a power station on board ship. Either single-screw or twin-screws can be adopted with any arrangements of prime movers.

"Whilst the cost of the Diesel-electric is slightly more than the other types, it has been estimated that with the increased carrying capacity, the increased cost could be written off in eighteen months' ordinary service, whilst the vessel will have the increased carrying capacity all her life; alternatively, a smaller and therefore cheaper vessel could be designed to do the same work.

"With the wide experience that has been obtained on land and sea in high powered electrical plant, one need have no misgivings regarding the electrical part of the installation. The machinery can be more easily arranged to meet the requirements of the design of vessel than most other types of machinery, and if necessary the motors can be placed aft and the shafting tunnels with long lines of shafting can be dispensed with.

"By using electrically-driven auxiliaries further running economy is obtained and considerable quantities of steam, exhaust and lubricating pipes can be dispensed with. In the modern twin-screw double-reduction geared installations the engine-room is so full of connections and fittings that the cost of overhauling or upkeep is a very serious item—any important repair necessitating disconnecting and moving of many pieces to enable the repair to be carried out.

"The Diesel-electric drive also offers many advantages for the moderate powered ship as compared with the Diesel direct-

drive and can be relied on to give flexibility and high economy.

"Each ship or each class of ship must, of necessity be dealt with on its merits and the type of machinery to be adopted must depend on the space available, weight and cost of installation, economy of the machinery as a whole and reliability.

"At the present stage of the development of the oil-engine it is certainly not possible to expect very high powers whether the arrangement be Diesel-direct or Diesel-electric.

"In conclusion, the most recent experience in ship propulsion seems to indicate that double-reduction geared-turbines and single-reduction are still subject to suspicion, the latter in a lesser degree. It would therefore appear that in moderate powered vessels it will be a choice between retaining the reciprocating engine or adopting Diesel-electric or Diesel-direct drive."

Mr. Johnson takes four ships of 325′ length and 46′ breadth and 2,500 indicated h.p. (steam i.h.p.) and compares the results of four types of machinery in this hull, namely single-screw triple expansion, single-screw turbo-electric, twin-screw oil-engines with electric auxiliaries, single-screw Diesel-electric drive, both motorships to have auxiliary power for steam heating.

The fuel-consumptions are given as 32 tons, 31 tons, 11½ tons and 12½ tons of oil respectively per day. Compared with the two types of steam vessels, the direct Diesel drive gives an increased capacity for cargo of 23,000 cu. ft. and the Diesel electric drive gives increased cargo capacity of 38,000 cu. ft. We presume these comparisons are made as the result of the experience of the Diesel-electric driven vessels they are now building for the United Fruit Co. of Boston, and with similar steam-driven craft.

Salvaging a Steamer by Diesel-Power

Swedish Motor Salvage-Ship Assists Dutch Steamer in Distress

While we have not yet built in this country a motor salvage-vessel, the Göteborg Salvage & Towing Co. of Göteborg, Sweden, has in most successful operation such a craft—the FRITIOF. This craft was illustrated and described in the December, 1920, issue of MOTORSHIP, and in the June, 1921, issue there was shown an illustration of this vessel towing a very large floating dry dock. As salvage work involves the most severe strains and the hardest of towing in the worst weather the successful employment of the Diesel-engine in this service speaks volumes for this type of power. There are many who undoubtedly feel that steam is the only power with the flexibility and overload capacity necessary for this work; their ideas must be drastically revised in the light of the performance of the Diesel-powered FRITIOF.

It will be remembered that she was built by Götaverken of Göteborg, and delivered early in 1921, the first of her type. By referring to the December, 1920, issue of MOTORSHIP it will readily be noted from the designs of this vessel published on page 1069 that she embodies many unique features. She is propelled by two six-cylinder Burmeister & Wain type Diesel-engines built by Götaverken, each developing 625 i.h.p. at 150 r.p.m. with cylinders 15.748″ bore by 29.527″ stroke. In addition to the main-engines there are three 90 i.h.p. Diesel-engines connected to electric generators for furnishing current for the electric-driven salvage equipment. This consists of two 16″ salvage pumps in the engine-room and two portable plunger-pumps and three 8″ portable salvage pumps. A donkey-boiler provides steam for the steering-gear, anchor windlass, two 5-ton winches, a 10″ towing-winch, and a 12″ salvage pump. The total capacity of her salvage pumps is 6,000 tons per hour.

Because of the fact that the Göteborg Salvage & Towing Co. own and operate a fleet of 25 steamers and tugs, all propelled by steam engines up to 700 i.h.p. they are in a fair position to judge of the merits of both steam and Diesel power. Capt. Carl Malmborg, the general manager of the company, recently made a trip on the FRITIOF when she salvaged the 9,000 tons Dutch turret-steamer ADMIRAL DE RUIJTER, which had been damaged in a head-on collision with the Norwegian coast. Upon his return Capt. Malmborg wrote an interesting report of the part played by the FRITIOF in a letter to the directors of Götaverken, from which report we will quote as follows:

"The ADMIRAL DE RUIJTER was empty and had been damaged at the bow and collision-bulkhead by grounding on the Norwegian coast; a temporary concrete cofferdam had been fitted and a steam-tug of 900 i.h.p. was engaged to convey and tow the steamer from Bergen to Rotterdam. In the Skagerack the steamers met a strong S.S.E. wind, so that the tugboat couldn't keep the steamer against the wind and had to let go the towline while the ADMIRAL called for assistance by radio.

"The FRITIOF caught the message in Gothenburg and left at 1.30 p.m. Thursday, Feb. 8th, while a salvage steamer of nearly equal power belonging to another company left Fredrikshamn in Denmark at 1.00 o'clock. The salvage steamer passed the Skaw about six nautical miles ahead of the FRITIOF, but was overhauled and passed by the FRITIOF, which arrived alongside the ADMIRAL one hour ahead of the steamer. Our vessel rode the waves like a duck and kept the decks perfectly dry, while the salvage steamer plunged heavily and took water over the bulwarks. The FRITIOF got the job, made fast his towline to the ADMIRAL and started to tow, together with a steam tug from Norway. The ADMIRAL also started her engine and after a while the steam tug had to let go on account of the speed getting too high.

"The tow arrived in Esbjerg, Denmark, at 2 o'clock Saturday morning and left again for Rotterdam at 4 o'clock in the afternoon. Over the Bay of Heligoland the wind increased from a direction a little aft of amidships, the FRITIOF rolled heavily but didn't take any water over the gunwales, a mean speed of 8.7 knots being maintained. During a trip of this kind with a big ship in tow making a considerable speed it is of the utmost importance that the tugboat be able to rely on her machinery, for in case anything happens the tug can be rammed before she can steer clear or throw the towline. The motors of the FRITIOF worked like a well-adjusted watch. The revolutions were constantly 140, which I appreciated very much. To keep same constant on a steamer is very difficult.

"When the tow was finished off the coast of Holland, we were speeded away with a courteous radio message as follows: 'Thanks very much for splendid services. Wish you a speedy voyage home. Denbroeder Debeer Capt. Knop Admiral de Ruijter,' which may be taken as a token of satisfaction from the owners.

"On the homeward voyage we kept a moderate speed of 11.2 knots at 140 revolutions. During the race with the salvage steamer before approaching the ADMIRAL, we counted 158 revolutions and 12.2 knots. My experience during the whole trip can be condensed in a few words: 'FRITIOF is the ideal salvage ship.'"

TRIALS OF THE M.S. "BESSIE"

The wooden bulk-oil carrier, BESSIE, owned by the Phoenix Fuel Supply Corp. of New York City, and powered with a 95 h.p. Wolverine oil-engine ran her trials on March 16th on Long Island Sound off Bridgeport. The May number of MOTORSHIP will include full information.

Motor salvage vessel "Fritiof"—First of her type

Diesel-Engines on United States Battleship

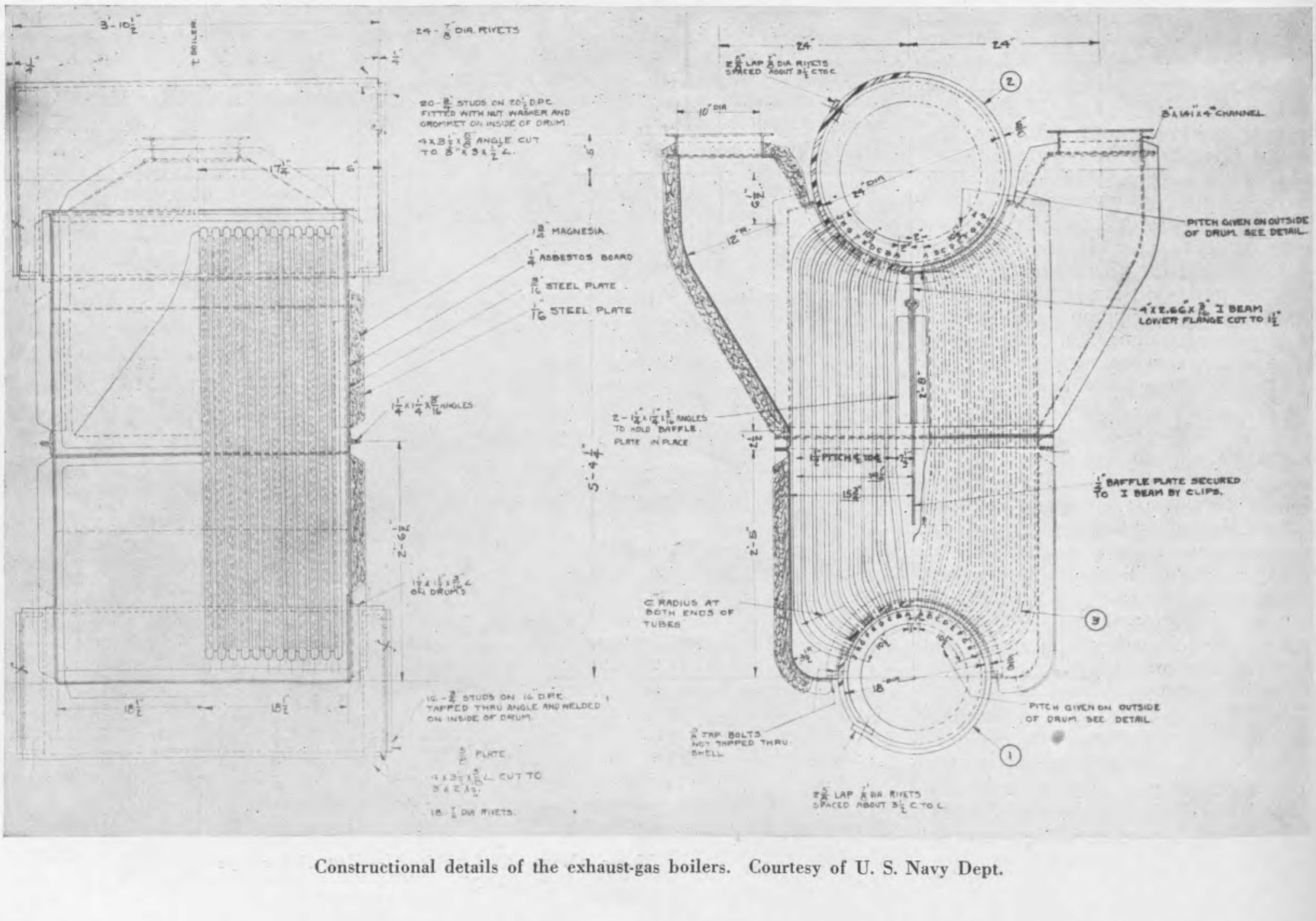
First Published Details of Installation of Busch-Sulzer Diesel-Engines, General Electric Motors and Waste-Heat Boilers on the Dreadnought "Maryland"

DIESEL-ENGINES are becoming more numerous in naval craft as their advantages for certain uses are becoming recognized, several propelling-sets as well as ship's auxiliaries being now installed in the world's navies, not to mention the great fleets of submarines which are Diesel-propelled. However, one of the most interesting American naval installations we have seen is that being made on the Navy's greatest fighting machine, MARYLAND, which we were recently enabled to inspect through the courtesy and permission of Edwin Denby, Secretary of the Navy.

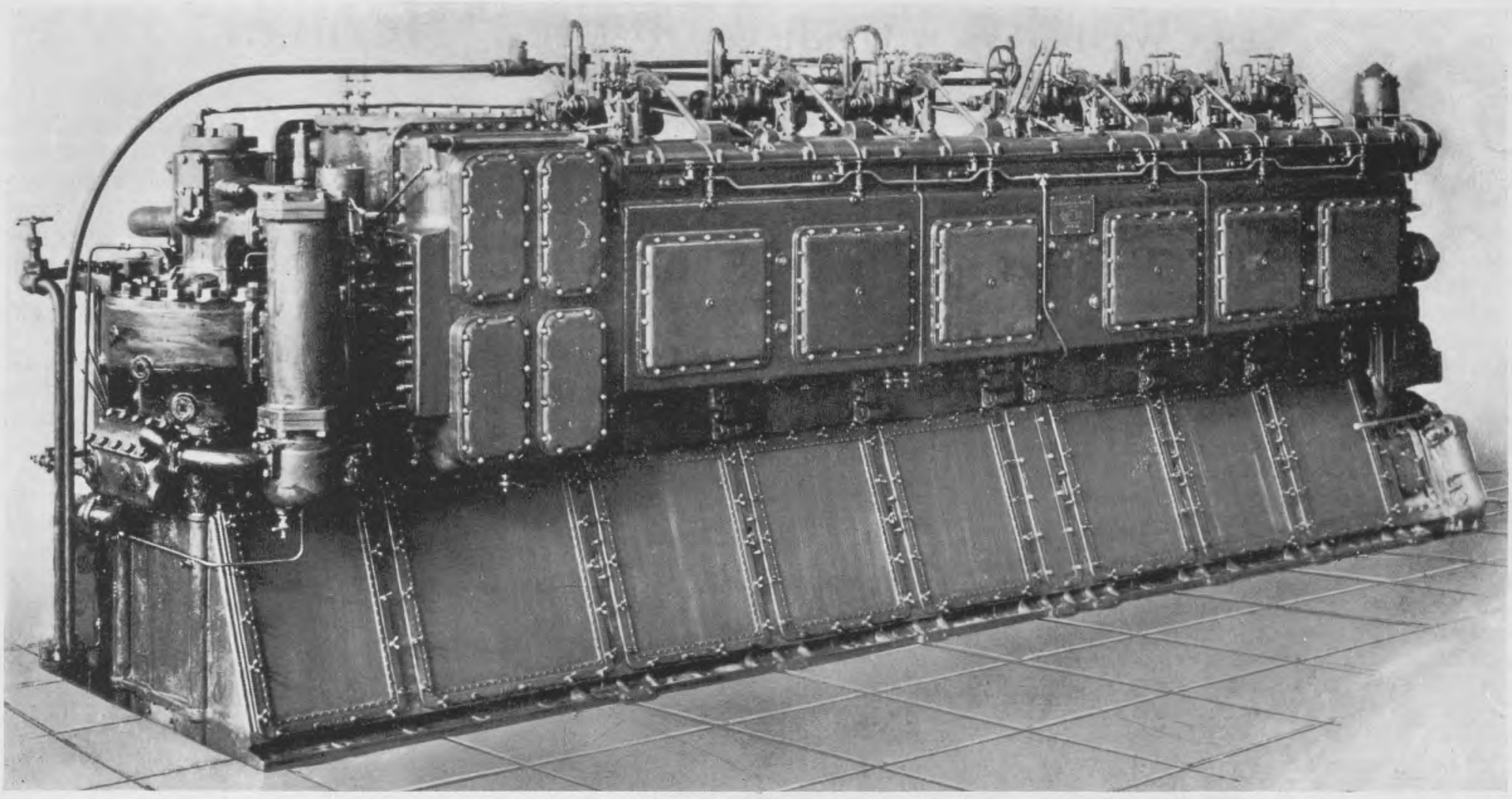
Not only does this plant include Diesel-engines and electric-generators, but the waste-heat of the exhaust-gases is utilized in an exceedingly interesting manner. The entire equipment is installed in a watertight compartment on the starboard side outboard and forward of the main engine-room, the only means of entrance or exit being up-and-over. There are no port-lights or other openings to the outside of the ship, but ventilators are arranged in connection with blowers. The chief purpose of the installation is to do away with the use of some of the ship's boiler equipment while in port, the Diesel-electric and distilling-set being much more economical than the boiler. However, the demands of steam for galleys, laundry and heating are now greater than a small Diesel set can supply. But the present installation will supply electric-current for lighting and power and steam for fuel-oil heating and for distilling fresh-water.

Auxiliary-Diesel engine-room on U. S. S. "Maryland," with the two 900 b.h.p. Busch-Sulzer Diesel engines in course of erection. Note exhaust-gas boilers in the background

Two six-cylinder Busch-Sulzer two-cycle Diesel-engines are installed in a compartment with the exhaust-heat boilers, the electric-generators being installed in another space forward of these and driven by a shaft extending through the bulkhead forward from each engine. Each engine will develop 900 brake h.p. at 350 r.p.m., but they will be operated at 300 r.p.m. to give 400 k.w. at the generator. When the installation is completed and put in operation Diesel-oil will be used for fuel for a half-hour upon starting and a half-hour before stopping, boiler-



Constructional details of the exhaust-gas boilers. Courtesy of U. S. Navy Dept.



One of the 900 h.p. Busch-Sulzer auxiliary Diesel-engines of the U. S. Battleship "Maryland"

oil being regularly used while running. Eventually oil as low as 10 degrees Beaumé will be used—at least, we were given to understand. This, of course, is an exceptionally heavy oil. Daily service tanks of 150 and 300 gallons are provided on the forward bulkhead of the engine-compartment.

At the aft end of this space, as illustrated in the accompanying view photographed by permission of Secretary Denby before completion of the work a few days before the MARYLAND put to sea, are two exhaust-gas boilers, one for each Diesel-engine. These were designed by Commander C. A. Jones of the Bureau of Engineering, Navy Department, through whose courtesy we are enabled to publish drawings of these interesting units. Each of these boilers contains 424 tubes of 1" outside diameter, 95 mils. thick and has a heating-surface for the tubes only of 445 sq. ft., these tubes being of seamless cold-drawn steel. Provision is made for cleaning the tube surface in the event of deposits from the waste-gases. The test pressure for the boilers is 50 lbs. per sq. in. and the drums are open hearth medium steel. Insulation consists of carbonate of magnesia containing about 8 per cent. asbestos fibre.

It is expected that an average of about 400 to 500 lbs. of steam per hour will be generated at the average load condition which the generator will carry when producing light and power for the ship. The exhaust-line of the engine is fitted with arrangements for by-passing the boiler so that in case of necessity the engine's operation need not be interfered with during overhaul or cleaning of the boiler. Feed for the boiler comes from the regular freshwater boiler-feed system of the ship. Steam will be generated for the primary purpose of obtaining steam at 10 lbs. pressure to be used for heating the fuel-oil piping and any excess of steam to be utilized in the ship's distilling-plant for the production of freshwater.

The electrical equipment is by the General Electric Co. and the generators are three-wired, equipped with balancing sets for voltage regulation. Double-throw switches are provided to give 120 volts for lighting circuit and 240 volts for power. This installation will produce sufficient current to take considerable load off the ship's steam-plant.

AMERICAN MOTORSHIP "MUNCOVE" IN SERVICE

"Muncove," ex "Covedale," the second of the Lake-type Shipping Board steamers to be converted to McIntosh & Seymour Diesel power for the Munson Line ran trials during the second week in March and has gone into the Norfolk-New England service. She was converted by the Sun Shipbuilding Co. at a cost of about $150,000. The main Diesel engine is of 900 i.h.p. at 135 r.p.m. For providing deck power and engine-room auxiliary power there are three 3-cylinder four-cycle 7½" x 11" Winton Diesel engines of 65-67 b.h.p. at 450 r.p.m. connected to 40 k.w. generators. There are also two Winton electrive-driven maneuvring air-compressors of which one is a stand-by, and one small Winton kerosene-driven emergency compressor. There is a 10 k.w. set for lighting.

BALTIMORE FIRM TO CONVERT STEAMER

It is very probable that the Baltimore Steamship Company will purchase a steamer from the Board and convert her to Diesel power before the end of this year.

SWAN HUNTER'S NEW AMERICAN CONNECTION

Swan Hunter & Wigham Richardson, Ltd., Newcastle-on-Tyne, builders of the Neptune two-cycle Diesel engine, and controllers of the North British Diesel Engine Co. of Glasgow, have become associated with the New York Harbor Dry Dock Co., Inc., Clifton, Staten Island, and will carry on repair work, etc.

WHY FEW MOTORSHIPS ON GREAT LAKES?

A ship operator on the Great Lakes who is a reader of MOTORSHIP and who happens to have coal connections himself, advises us that it is believed that motorships are not used on the Great Lakes because every large fleet, small fleet, and most brokers, and most vesselmen of the lakes have some coal connection with some firm whereby they are assured cheap fuel, and a commission on soal sales, etc. The year 1922 Lake boats used 829,181 net tons of coal for fuel and the price paid averaged $7 per ton, and ran from $11 to $8 during the strike. In 1921 fuel coal for Lake boats was 759,069 tons, and in 1920 1,258,783 tons. Furthermore there is a lack of oil fueling stations for motorships.

FRENCH RIVER MOTOR-TUGS

For towing service on the River Seine the French government toward the end of the war put in service a number of motor-tugs built in various shipyards; many of these tugs are still in service even after the emergency for which they were built passed. There were 16 tugs fitted with 400 h.p. Diesel-engines. Ten were built by the Forges et Chantiers de la Méditerrané at Toulon, France, and were equipped with two-cycle Sulzer Diesel-engines while six others having Swedish constructed Polar Diesel-engines were built by the Chantiers de Barriol at Arlese, France.

These tugs, operating in competition with numerous steam-tugs plying between Paris and Rouen, showed to good advantage over the older type of boat. The fuel consumption of both types of Diesel-engines was about the same, i.e., about 225 grammes (0.45 lb.) per h.p. hour, requiring for the round-trip Paris to Rouen and return 3½ tons. The steam-tugs required for the same trip 35 tons of coal, the horse-power being practically the same in both cases. On both motor and steam-tugs the same number of crew was carried.

Noteworthy Voyage of the "Herman"

Whaler Gives New Atlas-Imperial Diesel-Engine Seven Months' Test in the Arctic

ONE of the best known Arctic trading and whaling vessels of our Pacific Coast is the three-masted wooden auxiliary schooner HERMAN, owned by H. Liebes & Co. of San Francisco, Cal. In the many years she has voyaged into Northern waters many desperate battles with ice have been encountered, none, however, as severe as conditions met on this latest voyage. Each Fall upon her return to San Francisco she has brought most thrilling tales as well as motion pictures of Arctic scenes, of lassoing polar bears, harpooning whales, etc., and has often been of the greatest assistance to Arctic explorers. She rescued Capt. Bartlett of the wrecked KARLUK of the Stefannson Expedition and brought Capt. Amundsen to Nome, Alaska, and gave to the world the first news that his schooner MAUDE had been disabled in the attempt to drift across the North Pole. Upon her return last Fall she had no news of Arctic exploration, but did return with news of the perfect performance of her new 250 brake h.p. Atlas-Imperial Diesel-engine which had seen its first service.

For the past seven years the HERMAN had been powered with a 250 h.p. Atlas distillate-engine and previous to that was propelled by steam. As the MORNING STAR this historic vessel was built at Bath, Me., in 1884, and after many years' service as a missionary vessel in the South Seas she was purchased by her present owners. They have eleven trading stations in the Arctic distributed over a distance of over a thousand miles and to this must be added thousands of miles to reach the North, so that a round trip of about 12,000 miles is necessary. The primary object of installing the Diesel-engine was to gain space for cargo, as this engine uses so much less fuel than the former distillate-engine which had given perfectly satisfactory service for seven years. Yet a gain of 50 tons of cargo space and increased radius were extremely valuable, not to mention a saving of approximately $12,000 in the fuel bill for one trip. The previous distillate-engine consumed 25 gallons of fuel per hour at a cost of 16½ cents per gallon, $4.12 per hour, while the Diesel-engine uses only 8 gallons of oil per hour costing 4¼ cents a gallon, or 34 cents an hour, a saving of $3.78 per hour on fuel.

The engine which makes possible such economy is of four-cylinders 11½" bore and 17" stroke and turns a four-bladed propeller of 86" diameter and 52" pitch at 210 to 220 r.p.m. The HERMAN is 131' 3" long, 29' 9" breadth and 12' 2" depth of hold and on her voyage carried 625 tons of supplies and merchandise at 8 knots, whereas she previously averaged 6½ knots. The advantage of this extra speed is well indicated in the fact that when the HERMAN left San Francisco on April 15, 1922, she ran for 17 days on the open ocean to Dutch Harbor, Unalaska, this trip having never been run in less than 23 days with the previous power.

Here we will allow her skipper, Capt. C. T. Pedersen, to describe this voyage among the dangers of the Northern waters, for after leaving Dutch Harbor there are no harbors of any kind, the HERMAN in making her various stops at trading-posts being obliged to anchor in the open sea, exposed to wind and sea as well as floating ice, which often necessitates shifting position as often as ten times during a night while anchored. The value of a quick-starting Diesel-engine is here appreciated. Capt. Pedersen writes of the voyage in these words:

"After leaving San Francisco we steamed 5 consecutive days without a stop, and as the Chief thought it would be nice to examine the spray nozzles the engine was then stopped for 15 minutes, after which we steamed for 12 days without a single stop until our arrival at Unalaska. Before installing this engine, we had been a little worried whether it would be a success in working the ice, as we always have to do more or less backing in breaking up the ice and forging our way through the pack. In my 28 years' experience in navigating the Arctic Ocean, I have never encountered such an icy season as the one just past: on July 25th the pack was over 200 miles south of its usual position, and it refused to budge but very slowly from then on.

"It was August 23rd before we rounded Point Barrow bound East, and we had to stop here and there to trade with the Eskimos along the Coast, and also land cargo for our Station at Demarcation Point: at this place we had to spend 2½ days during a snowstorm, as the ice was sweeping by so thick and fast that we were unable to land any cargo until after the second day. It was August 30 before we reached Herschel Island due to this delay. From there we proceeded to the mouth of the Mackenzie River. All the land in sight was covered deep with snow and young ice was making, but still we proceeded further East until we arrived at Baillie Island on September 6. We found this place (Baillie Island) entirely out of provisions, as the Hudson Bay Trading Company's post here had sold out everything, and their vessel did not come beyond Herschel Island. We had to let their trader have some supplies for his own use for the winter.

"On September 7 we turned back and proceeded west as fast as possible in the hope of getting round Point Barrow before the freeze-up, but when we arrived within 70 miles of Point Barrow we found the young ice making so fast that we were unable to make any headway, and I had to do what I have done once or twice before in my experience in the Arctic, that is, rig an ice-cutter from the end of our jib-boom, and so cut the ice ahead of the ship. This rig consists of a 6"x6" spar—a little longer than the beam of our ship—with one small boat-anchor lashed on each end and also one in the center. This rig is then suspended from our jib-boom across the bow so that the lower flukes of the anchors will keep under the young ice and tear its way through. We also use guy-lines from each end in order to keep the rig in place. With this in operation we made a speed of almost 5 miles per hour, whereas we had been only able to make about 1 mile per hour previous to this.

"After rounding Point Barrow we found the ice-pack was well in on the Coast for more than 75 miles to the southward, but we had no trouble in getting out, and kept steaming south until we reached San Francisco on October 27. We steamed the entire way as our engine was in fine shape, and we had more fuel than we knew what to do with. We even landed 8,400 gallons of fuel in the Arctic, which we are keeping for our next summer's use.

"I cannot speak too highly of the Atlas-Imperial engine, and feel sure that we would have been in the Arctic this winter if we had to depend upon our old gas-engine to work through all the ice encountered this past summer."

Her chief-engineer, Olof M. Hansen, has compiled a record of the fuel-consumption of this remarkable voyage as follows:

Voyage, 7 months and 10 days.	
Total running hours of engine	2,283½
Total amount of fuel taken on board at start, 30,482 gallons, at 4.16 cents per gallon......	$1,268.05
Total amount of fuel left in Alaska for next year, gallons...	10,450
Total amount of fuel in tanks on arriving at San Francisco, gal.	2,010
Fuel used in 2,283½ hours running, gallons................	18,022
Or 7.9 gallons per hour in the 250 h.p. Diesel-engine.	
Lubricating-oil used in 2,283½ hours, gallons	561
Or 1 gallon every 4 hours.	

In connection with this figure for lubricating-oil it is pointed out that the amount includes the consumption not only of the main-engine, but also of the auxiliary 3 h.p. engine and compressor, the 5 h.p. distillate electric-light engine and the 12 h.p. distillate hoisting-engine. Chief Hansen's statement that "the engine was put to the most severe test and it is my pleasure to report that no trouble whatsoever was experienced with this engine" is a tribute to the HERMAN's Atlas-Imperial Diesel-engine on a maiden voyage of 12,000 miles under extraordinary conditions. For Chief Hansen goes on to say, "The engine is equipped with a reverse gear, and at one stretch while bucking ice the reverse-gear was constantly in use for 36 hours, during which time we made less than one-half a mile. This would prove beyond a doubt that the reverse-gear is practical for vessels bucking ice and where quick handling is desired. Before leaving San Francisco 30,482 gallons were placed on board with expectations that this would be sufficient for our summer cruise. However, to our satisfaction, 10,450 gallons were left in various ports in Alaska to be used by us on our next year's cruise and arriving in San Francisco found 2,010 gallons, or 18 steaming days' fuel left in our tanks. This, to my mind, proves the economy of this mechanical-injection Diesel-engine."

The HERMAN is now becoming a veteran and soon will be replaced by the H. D. BENDIXEN, which is having a 350 b.h.p. Atlas-Imperial Diesel-engine intalled.

THE AMERICAN SHIPBUILDING INDUSTRY

During the first two months of 1923, contracts for new construction amounting to considerably over $5,000,000 were placed with American shipyards, and there is sufficient new business in sight to expect that double this amount will soon be released,

Interesting News and Notes From Everywhere

A Diesel-engine repair shop has been opened on the River Thames, London, by Harland & Wolff.

The United Steamship Co. of Copenhagen, owners of six motorships, earned 6,800,000 kr. net during 1922.

It has been decided by the Standard Oil Co. of California not to convert Barge No. 95 to Diesel power, as originally intended.

It is probable that Diesel engines will be fitted in a number of the 600 barges being supplied by Germany to France and Belgium under the Reparations agreement.

A Krupp 420 b.h.p. Diesel engine propels a fishing vessel which has just been converted by Krupps of Kiel, from the German mine layer "M.-138."

Two 850 shaft h.p. Krupp Diesel engines are being installed in a large motor yacht now under construction for the Khedive of Egypt.

A paper on Internal Combustion Engines for River Vessels was recently read at the Technical University of Delft by Ir. B. V. van der Hegge Zinjen, who received the gold medal of honor.

The war-time built wooden motorship BABINDA caught fire and sank off Point Sur, near Santa Cruz, on March 4th. It is reported that the flames started from the electrical installation.

The oil-engine business of the August Mietz Corp., New York City, has been purchased by the Charter Gas Engine Co., of Sterling, Ohio, and in future Mietz oil-engines will be manufactured at Sterling.

Fearnley & Eger of Christiania have ordered a motorship of 7,500 tons d.w. from the Deutsche Werft of Hamburg. This vessel will be driven by a single A.E.G.-B. & W. Diesel engine of 2,600 i.h.p.

The American motor-tanker PINTHIS has been sold to the New England Oil Refining Co., Boston, Mass. She is of 1,750 tons deadweight and is powered with a 500 h.p. Bolinder oil-engine.

The McIntosh & Seymour Diesel engined motorships GLENDARUEL and ORMIDALE are owned respectively by the Glendaruel S.S. Corp. and the Ormidale S.S. Corp., of 11 Broadway, New York.

A 125 b.h.p. Diesel engine has been installed in a 65′ fishing vessel owned by the United Fisheries Co., now being constructed at the Lake Erie Drydock & Mill Company's plant. She will be the largest of her type on Lake Erie.

Each of the Lombard Diesel engines being installed in the McDougall owned Diesel-electric freighters will have six cylinders 13″ bore by 19½″ stroke, and will develop 375 b.h.p. at 260 r.p.m. The propelling electric motors will turn at 185 r.p.m.

World's Record of New Construction, Ships' Performances and Other Matters of Note in the Motorship Field

The various factories of Benz & Co., at Mannheim, Germany, have been absorbed by the Motoren-Werke, Mannheim, A/G. Stationary and marine type Diesel engines are built by this company at their Neckerstadt plant in Mannheim.

Two single-screw motorships have been ordered from Krupps by H. C. Horn of Flensburg. In each vessel a 1,400 shaft h.p. Krupp four-cycle, 6-cylinder crosshead Diesel engine turning at 125 r.p.m. will be fitted.

The East Asiatic Company, of Copenhagen, owners of a big fleet of motorships, report a net profit of 18,982,000 kr. for 1922. The reserve remains at 62,500,000 kr. The sum of 1,698,208 kr. was written off war-time built vessels.

Trials of Wilhelm Wilhelmsen's new motorship, TITANIA, 8,000 tons d.w. and 3,000 i.h.p., were run on February 12th by her builders, the Deutsche Werft of Hamburg, Germany. She is propelled by two 1,500 i.h.p. A. E. G.-B. & W. Diesel engines.

SCOTTISH BORDERER, the 10,000 tons d.w.c. tanker just built by Denny Bros. for Tankers, Ltd., is having her twin 1,250 shaft h.p. Denny-Sulzer two-cycle Diesel-engines installed. They are four-cylinder sets 23.5 ins. dia. by 41.7 ins. stroke and turn at 120 r.p.m.

It is reported that Krupps have received another order from the German branch of the Standard Oil Co. of N. J., namely the Deutsche Americanische Petroleum Gesellschaft of Hamburg. This is for a twin-screw motor-tanker in which two 1,550 shaft h.p. Krupp Diesel engines will be installed.

Readers in Europe who are anxious to secure back copies of MOTORSHIP should take note that Mr. V. van der Grinten, Pension Oranje-Nassau, Heerlen, Holland, has for disposal a bound volume for 1920 and 1921 with the exception of numbers 1, 4 and 5, and a complete bound volume for 1922.

Only two oil-engines were exhibited at the Motor Boat Show held in New York, Feb. 21-March 3. These were a single cylinder Gernandt oil-engine manufactured by the Gernandt Motors Corp., Chicago, Ill., and a six-cylinder 450 b.h.p. Krupp Diesel-engine exhibited by the American Krupp Diesel Engine Co. of New York.

A pair of 1,400 i.h.p. at 125 r.p.m. Werkspoor type six-cylinder, four-cycle, crosshead-model Diesel marine engines have just been completed and preliminary tests run by R. & A. Hawthorn, Leslie & Co., Newcastle-on-Tyne, England. The standard Holland-Werkspoor design has been followed.

Two 500 b.h.p. oil-engined tugs have been ordered by the Port of Lighthouses Administration of the Ministry of Communications of Egypt. They will be built under a sub-contract by J. Samuel White & Co., East Cowes, Isle of Wight, England, and each boat will be propelled by a 500 h.p. White-M.A.N. two-cycle Diesel engine. The contractors are Back, Manson & Hornblower of Alexandria, Egypt.

Two 1,000 tons d.w. motorships of 600 shaft h.p. each have been ordered from the Deutsche Werke A/G of Kiel, by the Reederei Aug. Bolten of Hamburg, for service between Hamburg and the Caspian Sea, via Petrograd and the canal system of the Marien River. Deutsche Werke four-cycle Diesel-engines will be installed. The vessels are building to the classification of the German Lloyd.

A small motor ferry-vessel has been placed in service in Amsterdam Harbor. She is 66½′ long by 17′ 4″ breadth and has accommodation for 30 passengers. She is propelled by a twin-cylinder, 70 shaft h.p. Kromhout surface-ignition oil-engine with an auxiliary gasolene motor for electric lighting. For heating purposes in winter time the exhaust-gases from the main engines are led by means of a special valve through a pipe system in the main cabin aft.

INDRA, a motorship of 6,870 tons, has just been launched by the Netherlands Shipbuilding Co. of Amsterdam. She is propelled by two 6-cylinder Werkspoor crosshead-type Diesel engines each of 1,400 i.h.p. giving her a loaded speed of 11 knots, while her auxiliary machinery will be driven by three Werkspoor trunk-piston type Diesel engines. She is built to the order of the Norwegian shipping firm of Winge & Co. of Christiania.

One of the largest coal-bunkering organizations in the world, Wm. Cory & Son, Ltd., has read the writing on the wall and realized that oil-bunkering is becoming a big business. They have now obtained the general selling agency of the Anglo-Persian Oil Company for bunker oils and are arranging to supply it at all the leading ports of Europe, Africa, Asia, and Australasia, making a special feature of Diesel-engine grades. Anyone who had predicted a few years ago that Cory's would one day be selling oil for motorships would have been deemed insane.

Pacific-Werkspoor Diesel-engines of 150 h.p. are being installed in four new tugs building in the Crowley yards at Oakland, Cal., for the Crowley Launch & Tugboat Co. Some time ago it was announced in MOTORSHIP that this company would convert eight of its fleet of distillate-engine tugs, but as four of these craft have been sold to the Shipping Board it has now been decided to build the four new hulls and install the Diesel-engines. These tugs will be 64′-6″ long, 18′-0″ breadth, 7′-0″ draft and of 65 tons. One of the Crowley steam tugs is now on the ways being converted and equipped with a 125 h.p. Pacific-Werkspoor Diesel-engine.

Dan Broström, the well known Swedish shipowner, was recently in England, where, it is reported, he negotiated for the construction of a passenger motorship.

TALISMAN, another Wilhelm Wilhelmsen ocean-going cargo motorship, has been launched at the Deutsche Werft.

A 100 foot motor-yacht is now building for R. E. Olds at the Defoe Boat and Motor Works, Bay City, Mich.

Now under construction at the Defoe Boat and Motor Works, Bay City, Mich., is another 65 ft. oil-engine fruit carrier for the owners of the sister motorvessel AMERICAN GIRL built at this yard last year and described and illustrated in MOTORSHIP.

A Nobel-Diesel marine-engine of 1,000 h.p. is now being constructed by Mirrlees, Bickerton & Day, of Stockport, England, the British licensees of the A-B Nobel Diesel Motorer, Sweden.

The Burgerhout Engine & Shipbuilding Co., of Rotterdam, Holland, is constructing a Nobel-Diesel two-cycle marine oil-engine of 2,000 to 2,500 shaft h.p. under license.

Several installations of Wolverine oil-engines are to be made in fishing-craft, among them being the following: 46 h.p. engine at New Bedford, Mass., by the Hathaway Machine Co.; another 46 h.p. engine at Douglas, Alaska, and two 70 h.p., three-cylinder engines in Maine boats.

EUGENE M. MORAN is the name of the boat owned by the Moran Towing & Transportation Co., of New York, recently referred to as to have a 375 b.h.p. Trout oil-engine. She is a wooden harbor tug of 88' length.

The United Dredging Company of New York City, has ordered a 125 h.p. Atlas-Imperial Diesel-engine for installation in one of their two boats.

Busalacchi Brothers of Boston, Mass., have ordered a 100 h.p. Fairbanks-Morse oil-engine to be installed in an ex-110 foot sub-chaser which will be used as a fish-carrying boat between Boston and New York.

Manuel Marshall of Gloucester has ordered four 45 h.p. Fairbanks-Morse oil-engines for his fishing craft.

On a recent voyage from London to Bombay, the British India Line's North British Diesel-engined passenger motor-liner DOMALA only consumed 17 tons of oil-fuel per day, and made the trip in 22 days, including time in all ports of call. The freight motor-liner DURENDA recently carried 11,800 tons of net-cargo from the Clyde to the Persian Gulf at an average speed of 10.6 knots on a daily fuel-consumption of 11.2 tons. The DUMANA, sister to the DOMALA is just completing. This big steamship company also owns the two North British Diesel-engined cargo motorships DWARKA and DUMRA, which carry about 2,000 tons at 10.5 knots on a daily fuel-consumption of 3.7 tons. A sixth motorship, the DALGOMA, only with Stephen-Sulzer oil-engines, also is nearing completion for this Line. She was launched on March 1st on the Clyde, and is of 4,000 shaft h.p. in twin screws turning at 100 r.p.m., or 3,000 shaft h.p. at 85 r.p.m. Her gross tonnage is 6,000. Length 430', breadth 54' 6", depth 33'. Two 410 auxiliary Diesels are installed.

Capt. A. S. French of Vancouver, B. C., is installing a 65 h.p. Atlas Imperial Diesel-engine in a 50-ft. ex-American naval picket-boat formerly steam-propelled. She is being remodeled for towing service.

ARCTIC, formerly the steam-schooner H. D. BENDIXEN, is being converted into a Diesel-driven vessel by the installation of a 350 h.p. Atlas Imperial Diesel-engine. She will replace the HERMAN, of the fleet of H. Liebes & Co., fur dealers, of San Francisco, Cal., which has made annual voyages to the Arctic waters for many years.

Apropos our article on "Sinking a Thousand Ships," it is very interesting to note that the American Merchant Marine Joint Committee, presided over by Mr. R. H. M. Robinson, President, United American Lines of New York, at a recent meeting resolved to recommend that the U. S. Shipping Board scrap all steel steamships unfit for normal commercial competition by reason of defective machinery or hull design. At the same time the Shipping Board has announced its intention of encouraging the conversion to Diesel or Diesel-electric power all good hulls with defective machinery and scrapping the balance of the vessels. The Board will not carry out the conversions, but will make suitable arrangements with shipowners for this purpose. It is expected that complete plans will shortly be published. There are about 345 hulls suitable for oil-engine power.

A 200 h.p. Fairbanks Morse oil-engine is being installed in the tug ALMARA at Vancouver, B. C., to replace steam machinery removed. She is owned by the White Rock Tug Co., connected with the Campbell River Lumber Co., who have large timber-lands on Vancouver Island. The ALMARA is American-owned and considerable difficulty has been experienced in obtaining Canadian registry because of the fact that, under American laws, vessels built in this country may only change their flag under conditions in which the United States Government retains a form of control. To this the Canadian Government is reported to have objected in the case of the ALMARA. She will be placed in log-towing and will be equipped with a powerful electric towing-winch and windlass, current for these, as well as for lights, being provided by a generating-set driven by a 15-h.p. single-cylinder Fairbanks Morse oil-engine.

Recently Francis R. Stewart, American Consul at Bremen, Germany, discussed the question of motorships with Capt. Koenig, formerly navigating officer of the German submarine DEUTSCHLAND, and now an active director of the North German Lloyd Steamship Company. Although Capt. Koenig is not an engineer, his wide knowledge of shipping in general and his experiences in handling both motor and steam-driven vessels in all sorts of conditions gives to his statement a character worthy of attention and consideration.

He is emphatic in his opinion that the future prospect for Diesel engines as the driving power for ocean-going vessels is very brilliant. Capt. Koenig states that German engineers are still divided in their opinion as to whether the two-cycle or four-cycle engine is the more suitable for ocean-going ships, and that the subject is very much discussed.

Capt. Koenig referred to one submarine which he commanded that ran for 25 consecutive days without her 1,000 h.p. Diesel engines being stopped once, either voluntarily or otherwise, and such small repairs as were needed on rare occasions were quite easily made by the engine-room staff. The Captain also recounted an incident of one Diesel engine which was driving a submarine during the war for the entire four years. After the armistice this engine was taken out and installed in a converted warship of about 1,800 tons and used for freight purposes. After running for two years in this converted vessel the Diesel engine was removed, the hull broken up, but the Diesel is now giving excellent service in a stationary power plant. We are indebted for this information to the Transportation Division of the Department of Commerce, Washington, D. C.

CURRENT REVIEWS

Brassey's Naval & Shipping Annual, 1923. Edited by Alex. Richardson and Archibald Hurd. Published by Wm. Clowes & Sons, Ltd., London. 548 pages. Price, 25s. net. Eagerly anticipated each year by naval and shipping men, this volume has made its 34th annual appearance and contains material of even greater interest than usual. In addition to the many timely articles by experts on naval matters, including the aspects and effects of the recent Washington Conference on limitation of armaments, there are included in this Annual twelve chapters on merchant shipping subjects. Among these are several which touch on motorships and the marine Diesel-engine, and tables and comparisons also shed light on the economical aspects of Diesel versus steam drive.

James Richardson's discussion of "Marine Machinery in 1922" summarizes the progress which has been made by the Diesel-engine, enters into consideration of the troubles which have been experienced with geared-turbine drive and takes up the subjects of motorship auxiliaries and motorship economies. A valuable article on "Economic Aspects of the Modern Cargo Steamer," by John Anderson, serves to further strengthen the position of the motorship, a detailed comparison of identical ships with various methods of propulsion indicating the tremendous economy which will be possible when it is practical to install Diesel-engines weighing but 50 per cent of the weight of geared-turbines and consuming but one-third of the fuel.

Catalog of the Deutsche Werke, Berlin, Germany. Printed in German. Unusually clear and attractive illustrations, showing the large Diesel-engines of this German shipyard and engine works, characterize this catalog. The full-page illustrations are printed on very heavy paper and the text is set in large and clear type. Diesel-engines from 125 to 2,350 h.p. are described, as well as auxiliaries.

Engine-Room Installations of Motorships

Suggested Improvements for the Lay-out of Auxiliary Machines and Equipment

By ROBERT C. BRUCE

IN these days when the economy and other advantages of Diesel-power are firmly established, it is fitting to consider the various features which tend to increase or detract from the general efficiency of motorships. The main propelling engines are the first part of the installation to come under consideration and it follows naturally that the greater part of the present day criticism has been levelled against them, the remaining portion of the installation being taken for granted. However, while admitting that the main engine is the most important item, it is by no means the all-important one, for given an efficient engine an equally efficient installation of auxiliaries is essential for perfect overall efficiency. This is easily proved by looking up the records of the trips of motorships as constructed from time to time by firms just entering this field, and who are not in proper touch with marine Diesel practice, and it will be found that the engines as supplied by some builder of repute have been in every way up to standard, but the maiden voyage has not been entirely successful due to some fault in the general installation.

It is the intention, therefore, in this article to deal with the subject of marine Diesel installations from the standpoint of efficiency as applying to the general mercantile requirements, and as guaranteed by modern up-to-date practice.

In some early motorships, where the whole business was looked upon more or less as a risky experiment, it was the practice to make a compromise with prejudice by fitting all steam auxiliaries, thereby retarding the advancement of the Diesel system due to the extra cost and complications involved under such conditions. This practice has now almost passed to oblivion, as it well deserved to do, and although a small auxiliary boiler is generally fitted it is usually for quite a different purpose altogether, the auxiliary machinery being as a rule driven by electric motors, and by internal-combustion engines. This latter system is the one which will be considered throughout this paper, and a typical floor plan for such a vessel is shown in Figure 1, in which the major portion of the necessary machinery is indicated, certain auxiliaries are not shown, such as the small boiler referred to, the fuel settling (or ready use) tanks, silencers, etc., as these are situated high up in the engine room.

The various details, of course, depend upon the design of the main engine to a very large

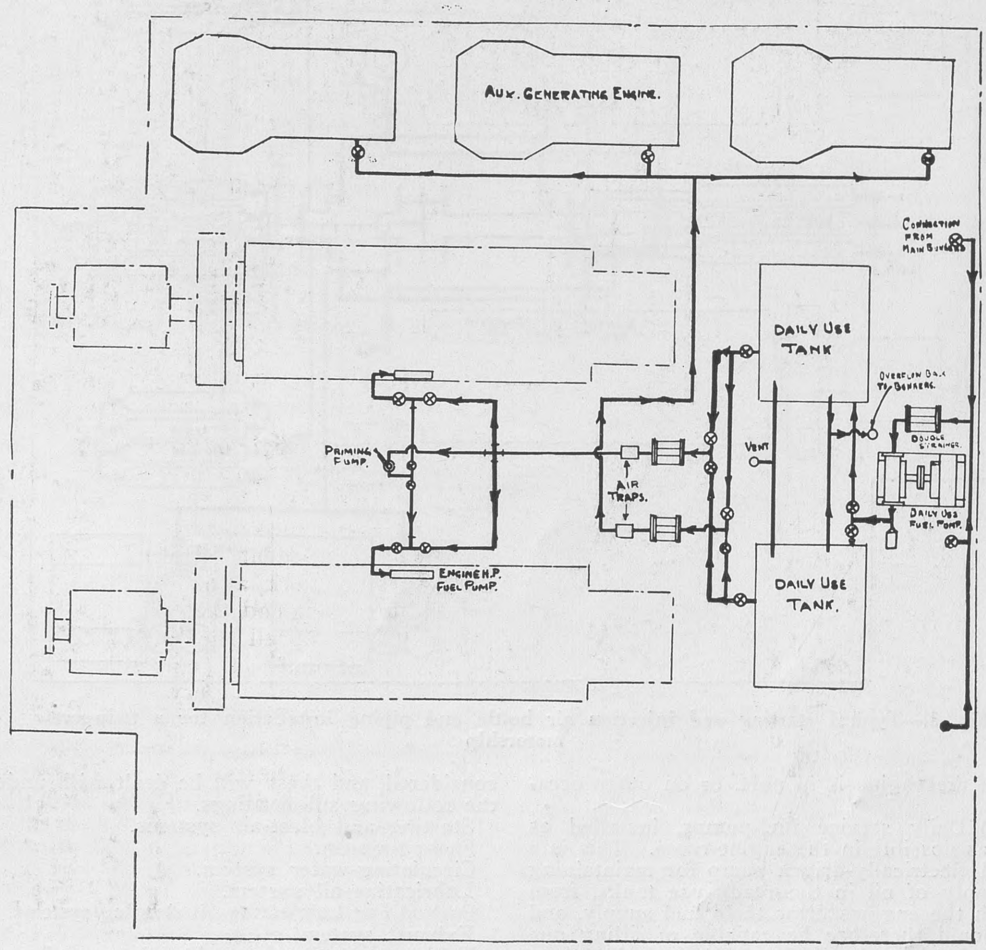


Fig. 2.—Fuel-oil installation of twin-screw motorship

extent, and so the more general line will be dealt with, and with this in mind it will be assumed that fresh water is used for piston-cooling purposes, and sea-water for the remaining requirements. If sea-water be adopted for all cooling, including the pistons, it will only require slight modifications to the following remarks.

The principal auxiliaries required in a ship as shown are as follows, see Fig. 1.

(a) Dynamo sets, in duplicate or triplicate driven as stated above but either surface-ignition, or Diesel engines. Each of these sets must be capable of supplying and maintaining sufficient power to operate all necessary motors, and for lighting and heating purposes. It is sometimes the practice to install one of these sets on either side of the engine room but it is perhaps a better arrangement to have them on the same side, as by this means the engines are all of the same hand, while in the event of the breakdown of one set the other is easily to hand.

(b) Air compressors in duplicate and each capable of maintaining a sufficient supply of air at the engine blast-pressure to fulfil the functions of the main-engine compressors in the event of either or both of the main compressors being out of action. A small hand air-compressor is also fitted to enable one of the starting reservoirs for the auxiliary air-compressor sets to be recharged by hand should the pressure in these be lost accidentally. In the event of the air-compressors being electrically driven the hand compressor may be used for recharging the reservoir for the dynamo set.

(c) Emergency dynamo set, installed as high as is reasonably possible, in the tween decks for instance. This is for supplying power for the wireless mechanism, in the event of the engine-room floor being flooded, and also for supplying electric light throughout the vessel

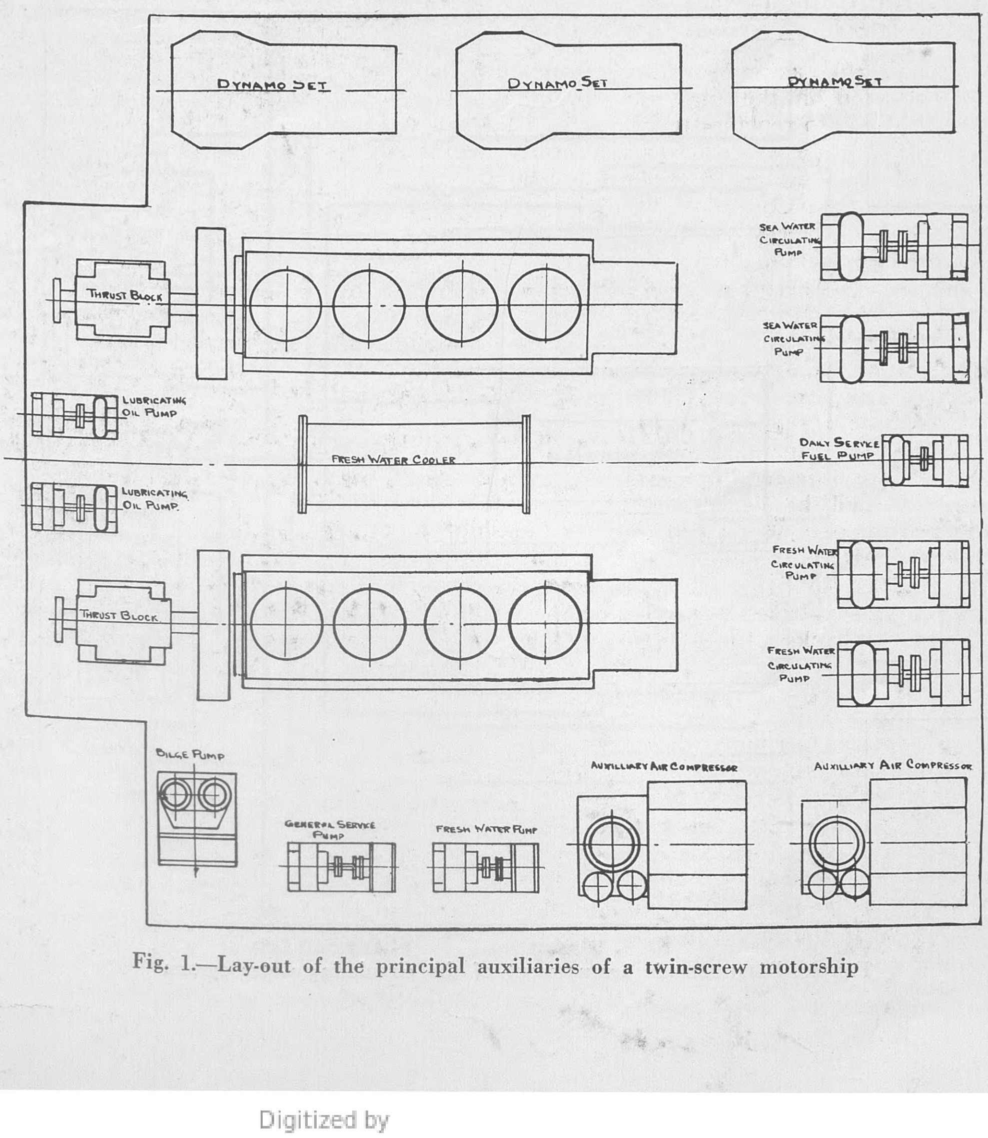


Fig. 1.—Lay-out of the principal auxiliaries of a twin-screw motorship

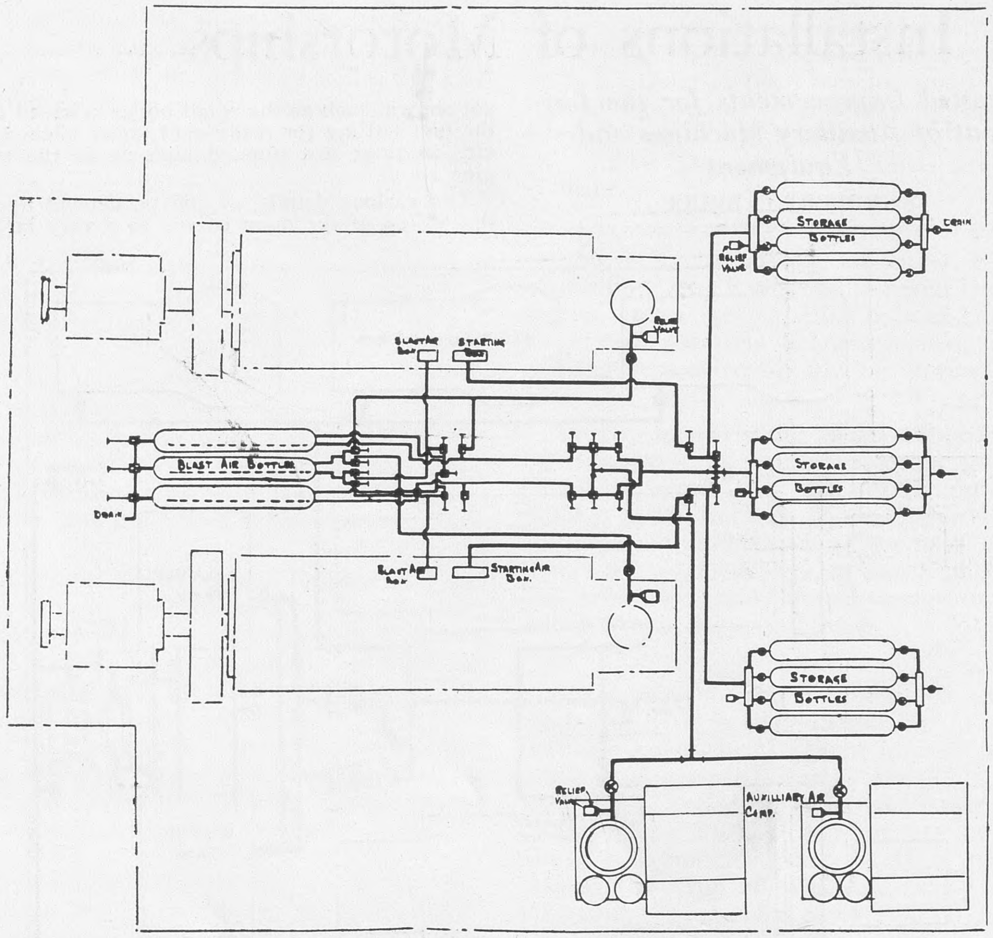


Fig. 3.—Typical starting and injection air bottle and piping installation for a twin-screw motorship

when the engine is in port, or on other occasions.

(d) Daily service fuel-pumps, installed as low as possible in the engine-room. This is a small electrically-driven pump for maintaining a supply of oil in the ready use tanks, from which the engines draw their fuel supply, and it should therefore be capable of filling one of the two tanks in 2 to 3 hours, the tanks themselves being about 12 hours running capacity. Thus one tank can be filled and left standing for practically nine hours while the other tank is in use, allowing thereby plenty of time for any moisture or foreign matter to separate from the oil. The pump may also be provided with suitable connections to enable it to be used as a transfer pump for the main bunkers.

(e) Sea-water circulating-pumps fitted in duplicate and each capable of supplying the total amount of cooling-water required for both engines, one pump operating while the other stands idle, each pump to be used at regular periods. The capacity of these pumps is based on an allowance of 10-12 gallons of water per brake horse-power per hour.

(f) Fresh-water circulating pumps fitted in duplicate and operated alternately as above and each capable of supplying the fresh water for both engines as calculated on a basis of 4-5 gallons per B.H.P. per hour.

(g) Lubricating-oil pumps fitted in duplicate, and having a capacity based on 2 gallons per B.H.P. per hour for both engines.

(h) Ready-use daily-service fuel-tanks, fitted in duplicate, as high as possible in the engine-room and each having a capacity large enough to supply oil to both of the main engines, and the auxiliaries for a period of 12 hours continuous operation.

(j) Air-storage bottles, for fuel injection and manoeuvring purposes the size and capacity will be given later.

(k) Exhaust silencer fitted in the stack, or other suitable place, and conforming to particulars given later.

(l) Donkey-boiler where required.

It is not proposed to deal in this article with any details of the installation which is not peculiar to the Diesel system, therefore such items as bilge and ballast pumps will be omitted.

The foregoing list has given the more important details but the actual systems, with the pipe lines, and smaller fittings have yet to be considered, and these will be dealt with under the following sub-headings.

Starting and blast-air systems.
Fuel-oil system.
Circulating-water system.
Lubricating-oil system.
Fuel-oil and Lubricating-oil cleaning systems.
Exhaust system.

Taking them in the order given, and considering the starting, and blast-air systems. As all starting and maneouvring operations are independent of the fuel-injection system, it will be as well to deal with them separately, and the fuel system will first be considered.

Air for fuel-injection purposes. This is supplied direct from the engine compressor to a distribution-box on the main engine, provision being made for either of the auxiliary compressors to take over this duty when required. A storage-bottle is placed on the pipe-line between the compressor and the distribution-box to enable a reserve charge to be kept in hand for starting or other purposes. This bottle also serves the same purposes as a separator for by leading the air into the bottle by way of a pipe leading to the bottom of the bottle, and by taking the outlet from the top, any suspended moisture is deposited in the bottom of the bottle from whence it may be drained from time to time.

Valves should be fitted to both the inlet and outlet sides of the bottle. In the case of twin screw vessels, each engine is provided with a storage bottle, while a spare bottle is also fitted which can be used for either engine as required. The capacity of these bottles may be ascertained by allowing 0.003 cubic feet capacity per B.H.P. per engine, for the two main bottles, and double this capacity for the reserve bottle where it has to feed two engines. The system finishes as far as engine room installation is concerned at the distribution box already referred to.

Starting-air system. The air for all manoeuvering purposes is carried in a series of storage-bottles usually placed on the engine room bulkhead, or in any other convenient place. These bottles are charged at the same pressure as the injection air, i.e., at the main engine compressor discharge. It is delivered to the main air starting valve by way of a reducing-valve which lowers the pressure to that desired for starting purposes.

In some vessels a low-pressure air receiver is also fitted in which air at a pressure of 300 to 350 lbs. per sq. inch can be stored. With air at this low pressure however the volume of the receiver has to be very large if a reasonable number of manoeuvring operations are to be performed without recharging, and so where space is valuable it can with advantage be dispensed with, and the reducing valve used in place. In motorships having an airless injection engine installation, the main engine requires no high-pressure compressor, and it is therefore cheaper to fit a low-pressure machine and to revert to the low-pressure air receivers.

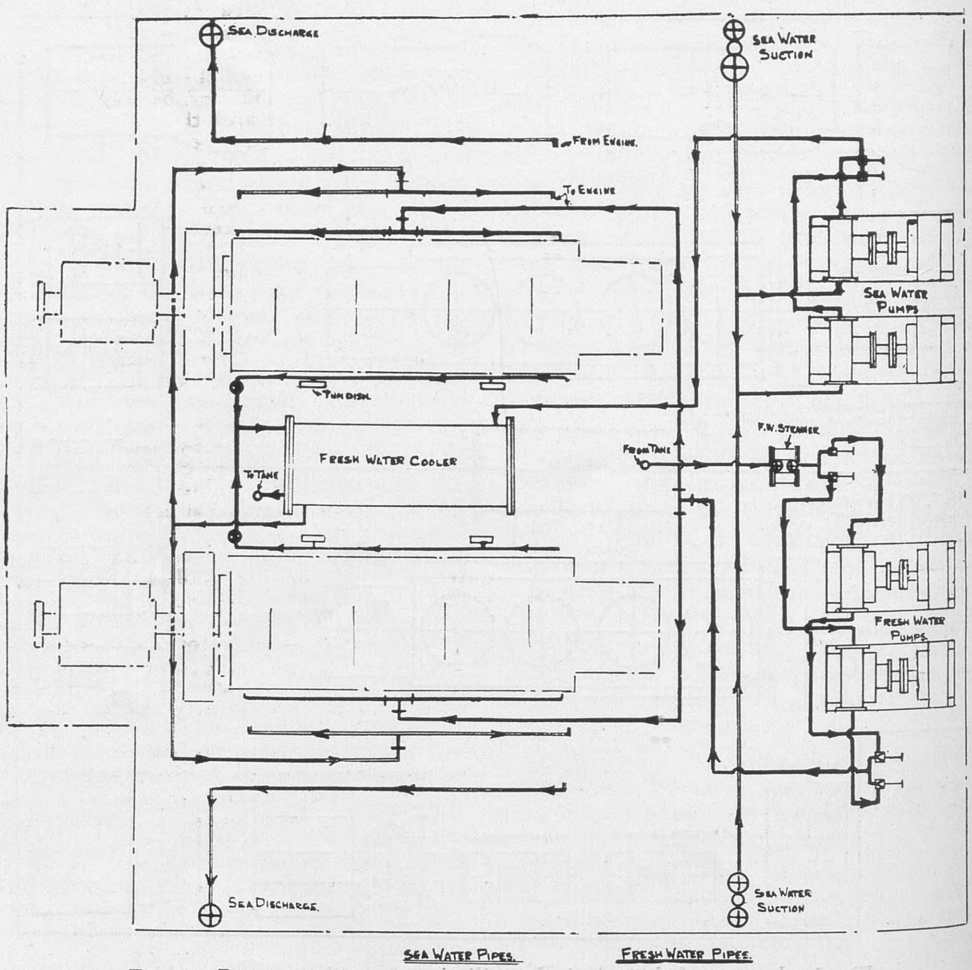


Fig. 4.—Diagrammatic arrangement of the circulating water system

All air bottles, both high and low pressure, should be carefully stressed out to the American Bureau or Lloyd's rules, or to the rules of the society under whose registration the installation is being fitted. All bottles must be provided with cleaning doors as large as is convenient, and these doors should be very accessible when the bottles are mounted in place. Isolating valves are necessary at both the top and bottom of each bottle in order that any defective bottle may be cut-off, without causing the remaining bottles to be blown down.

In a high-pressure system where a number of small bottles are employed, they should be divided into groups there being one working group per engine, and one spare group which can be used for either engine as required. Charging connections are fitted from both main engines, and also from the auxiliary compressors, to each set of bottles, screw down non-return valves being fitted on the discharge connections of each compressor. Each bottle must also be provided with a drain pipe and valve.

The pipe from the group of bottles is led to a manoeuvring-air master valve on the main air engine, and from this to a distribution box, the function of which is to distribute the air to the correct cylinders. All screw-down valves should be so placed that the air pressure acts on the underside of the valve when it is shut, in order to prevent leakage past the spindle. To prevent undue leakage when the valve is open, a mitre face is turned on the valve spindle, which bears hard on a seat on the valve spindle gland when the valve is open.

In addition to those already mentioned, further connections should be made from the storage bottles to the starting-air reservoirs for the auxiliary engines, preferably by way of a low-pressure receiver. If this latter connection be made the auxiliary-engine compressor need not be made to supply its own starting air, thus any air throttling device can be eliminated. The low-pressure receiver can also be used for supplying air to the steam auxiliaries, should any be fitted, and should steam not be available at the time.

A typical starting and blast air system is indicated in Figure 3, on which the pipe lines mentioned can be followed, this arrangement is of course merely in diagram form, for instance the starting-air bottles will be placed vertically in the vessel, and are shown horizontal for convenience in indicating connections.

Fuel-oil system. This comprises all pipes and fittings necessary to keep a constant supply of clean oil available for the main engine fuel pumps, and also for the auxiliaries. The daily-service fuel-pump mentioned previously is fitted to enable the oil to be pumped from the main bunkers to the daily service, or as they are sometimes called the ready use tanks. The latter are placed as high as is practicable in the engine-room, and their capacity should be a twelve hour one as mentioned before, conservatively based on a fuel-consumption for the engines of 0.5 lb. per brake horse-power per hour.

As one function of these tanks is to allow the moisture suspended in the oil to separate, ample drains must be fitted to the tank in order that it can be drained-off from time to time. The filling pipes must be large enough to allow of a maximum oil velocity through them of 100 to 120 feet per minute. Overflow pipes from the tanks to the main bunkers should have an erea equal at least to that of the filling pipes, while vent pipes are led from the tanks at their highest point out through the engine room skylight, and these should have an area at least one quarter of that of the filling pipe. As any moisture in the oil will naturally settle in the bottom of the tank the main feed to the engines should be taken from a point part way up the tank side, say about 1/10th of the height.

Where very heavy-oils are to be employed as fuel, or where the vessel will be called to operate in very cold climates it is advisable to fit heating coils in the tanks to enable the oil to be "thinned" in order that it may flow more easily. Possibly the exhaust gases can be used to generate steam for the purpose when at sea, and arrangements made accordingly. Also it is a good plan to instal one or two motor-driven centrifugal separators for removing ash-content and water from very heavy fuel-oils such as Mexican 14 to 18 degrees Beaumé fuel before passing to the engines.

A gauge glass of fairly large bore should

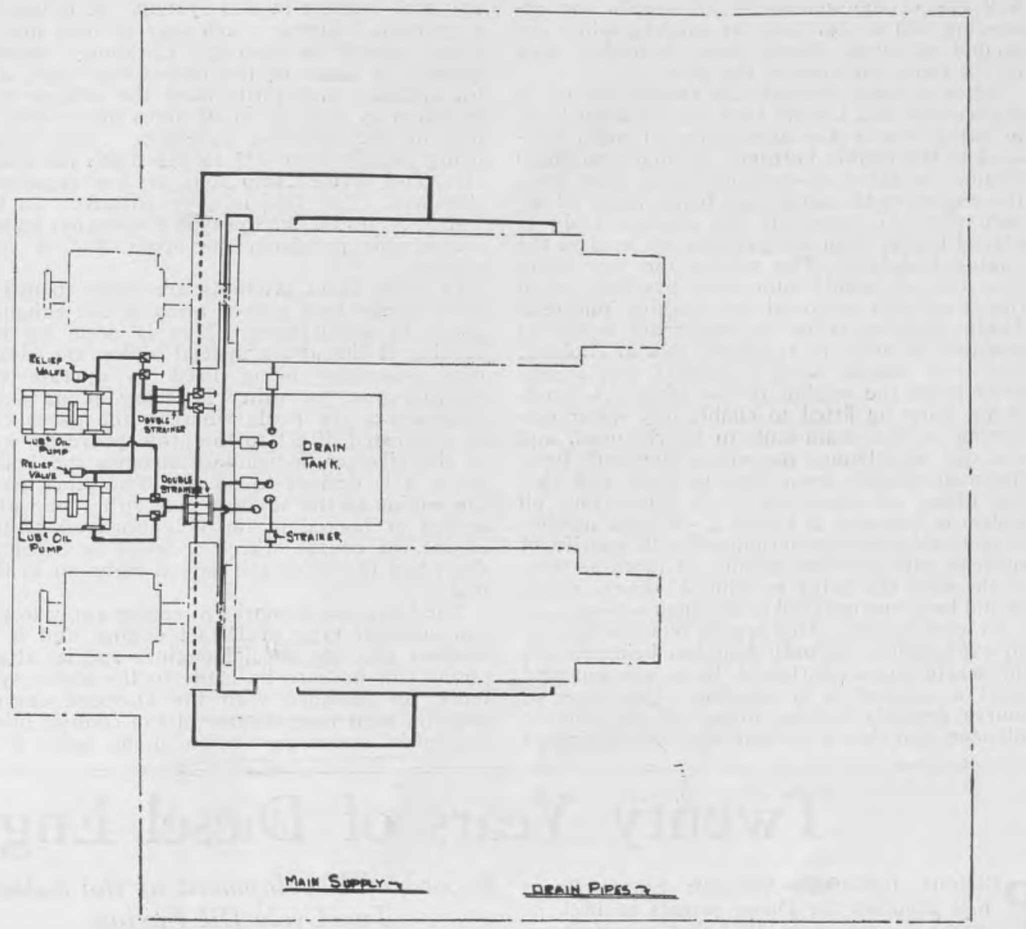


Fig. 5.—Arrangements for lubricating system in engine-room of twin-screw motorship

be fitted in order to enable fuel consumptions for the various engines to be obtained, and in this connection it must be noted that the pipes to the various engines should be entirely independent. These pipes must slope gradually but continuously down to the main high pressure fuel pumps in the main engines, the continuous slope being necessary to prevent air locks being formed. An air trap is a desirable feature on the pipe between the tank and the main engine, in order that any air bubbles in the oil may be collected, and released. Double strainers must be fitted between the daily service pump and the tank, and between the tank and the engine. The area through the baskets of these strainers should be 5-6 times the area of the pipe on which they are placed. With double strainers valves are fitted so that one cartridge can be removed and cleaned while the fuel supply is still kept up by way of the other cartridge.

To prevent any undue loss of oil various little points may be noticed, for instance the fitting of valves in place of faucets prevents a certain amount of loss, while the fitting of "save-alls" at places where leakage is likely to occur is also a saving; for instance below the main engine fuel-pumps, and also below the double strainers. It is a desirable safety device, to fit attachments by means of which all the main suction-valves can be closed from a point outside of the engine room. A fuel-oil system is shown diagrammatically in Figure 2.

Circulating water systems. In considering this system the assumption will be made that fresh water is used for the cooling of the main engine pistons. This is done for two reasons, first that by this method the risk of getting carbon deposits in the piston cooling-passages is very largely eliminated, and secondly that for cases where sea-water is used, the following remarks will largely apply, the only correction to be made will be to eliminate the cooler, and to circulate the sea-water through those passages supplied by fresh water.

The fresh-water system necessitates the carrying of a fairly large quantity of fresh water, this amount is lessened somewhat by fitting a fresh water cooler, and thereby using the water repeatedly. Sea water is, of course, used for the remaining jackets. The fresh water is stored in a tank situated in the double botton and is pumped from there by way of a double strainer to the main engine, where individual feeds are taken to each piston, the discharges from each piston being led to a "tun" dish where the temperature of any one piston can be ascertained. The drain from these "tun" dishes passes back to the tank passing en route through a cooler. The sea-water suction is drawn from overside through suitable strainers and is delivered first to the fresh-water cooler, and then on to the various jackets on the engine, being discharged finally overboard.

All pipes and passages must be of ample area to ensure that none of the pipes and fittings run the risk of being choked. Thermometer pockets should be liberally fitted throughout the system, and must be provided on both the sea, the fresh water inlets and outlets at the cooler, and also on all inlets and outlets on the engine. The cooler must be of ample cooling surface, and may be safely designed by allowing 0.6 square feet of cooling surface per BHP of the engine. Baffle plates must be fitted to direct the flow of the sea-water to the best advantage around the tubes, while retarders are also fitted in the tubes, to prolong the passage of the fresh water through the tubes. Further regulation can be obtained by fitting cocks on the sea water inlet and outlet pipes. Connections must of course be fitted to enable either of the duplicate pumps to be used. Figure 4 shows a diagrammatic arrangement of the circulating water systems.

It should be mentioned that expert opinion differs as to the water used for cooling. Most engine-builders use sea-water for both pistons and cylinders, others fresh water for the pistons with salt water for the cylinders, while Burmeister & Wain use fresh water for the cylinders and sea-water for the pistons.

Lubricating-oil systems. This system has to deal only with the lubrication of the main working faces, and bearings of the main and auxiliary engines, although the latter have more often a separate system, and are thus considered in this article.

The chief point to be watched is that the oil supplied is entirely free from dirt, and grit, therefore straining forms the chief feature of the system. The oil is drawn from a tank in the double bottom of the vessel by way of a double strainer. The pump should be placed as close to the tank as is consistent with convenience, in order to reduce the suction piping. Where it is necessary to fit a long pipe for any reason it is preferable to fit a foot-valve at the tank end of the pipe. The discharge from the pump is by way of another double strainer, and regulating valves to the engine. The size of the piping in this system should be such as

will ensure the maximum oil speeds not exceeding 200 to 240 feet per minute, while the double strainers should have a basket area of 5-6 times the area of the pipe.

After passing through the engine the oil is discharged, and travels back to the drain tank, in other words the lubricating-oil tank, situated in the double bottom. A single cartridge strainer is fitted on each discharge pipe from the engine to the tank, care being taken to ensure that the cover of the strainer body is placed higher than the greatest oil level in the engine bedplate. The reason for this being that the oil would otherwise overflow when the cover was removed for cleaning purposes Drain pipes must be as free from bends as possible, in order to avoid any risk of choking, and they should have a gradual, but steady drop from the engine to the tank. A hand-pump must be fitted to enable any water collecting in the drain-tank to be removed, and also for sweetening the oil in the tank from the main supply from time to time, and also for filling oil cans, etc. A lubricating oil system is indicated in Figure 5. A large number of motorships have been equipped with centrifugal purifiers with excellent results, as much as 60% of the used oils being re-claimed. Every vessel should have one installed in the engine-room.

Exhaust system. This system requires little or no explanation, its only function being to get the waste gases overboard, in as efficient and quiet a manner as is possible. Quietness of course depends on the fitting of an efficient silencer, and this is perhaps the only fitting of any real interest in this system. It is usually a cylindrical fitting which may or may not be water cooled as desired. Cheapness usually decides in favor of the non-cooled type, and for ordinary mercantile work the volume may be taken as from 25 to 30 times the volume of one of the working cylinders. The length being usually from 1¼ to 1½ times the diameter, and divided into four or five expansion chambers. This type is quite effective. In the United States the Maxim type silencer has gained considerable popularity for itself, and is very efficient.

In some cases attempts are made to utilize some of the heat passed away in the exhaust-gases to atmosphere. This is done by by-passing it through a special boiler, the steam thus generated being used to operate the steering-gear, or other auxiliary plant. Arrangements are made whereby the gases can be exhausted direct to the atmosphere by way of the silencer, instead of through the boiler when it is desired to do so. The pipes from the engine to the silencer may either be water cooled or lagged in the neighborhood of the engine, of course where a boiler is fitted as described the pipes are lagged right up to the boiler.

The foregoing remarks of course apply to the conventional type of Diesel engine, and it is obvious that for special engines special alterations will have to be made to the above systems, for instance with the Doxford engine with its high temperature piston-cooling inlet, and initial steam circulation in the jacket it is obvious that the foregoing remarks will not apply in their entirety. For general mercantile practice however, they will provide an excellent basis. The following notes give particulars of the new single-screw motorship PINZON, and give various proportions, in close accordance with the above:

"M. V. PINZON"—Displacement, 3,300 tons, length, 240 ft.; beam, 38 ft.

Single-screw 6-cyld. 4-cycle engine; bore, 620 mm x 975 mm, 120 RPM.

Brake—Horse-power, 1,250.

Air compression on main engine, 2—three stage 480 cub. ft. free air per min.

Aux. air comp., 176 cub. ft. per min. equals 0.141 per BHP.

Emergency compression—12 cub. ft. per min.

Starting-air Receiver—Max, press., 500 lbs. sq. inch. 3 of 70 cub. ft. each equals 0.168 per BHP.

Main engine blast bottles—Max. press., 1000 lbs. sq. in. 1 working, 1 spare, each 5 cub. ft. Proportion for one bottle 0.004 BHP.

Auxiliary Generator—2-50 K.W. Diesel-driven by 4-cycle 75 HP at 250 RPM.

Comp for Generating Engines—For one engine swept volume of comp. at 250 RPM 41.2 cub. ft. min. For two engines 82.4 cub. ft. per min.

Starting-Bottles, Aux.-Generator—2 per engine each 3.54 cub. ft. 0.094 BHP at 1,000 lbs. sq. inch.

Blast Bottle Aux. Generator—One per engine, each 1 cub. ft. 0.0133 BHP.

Twenty Years of Diesel Engine Building*

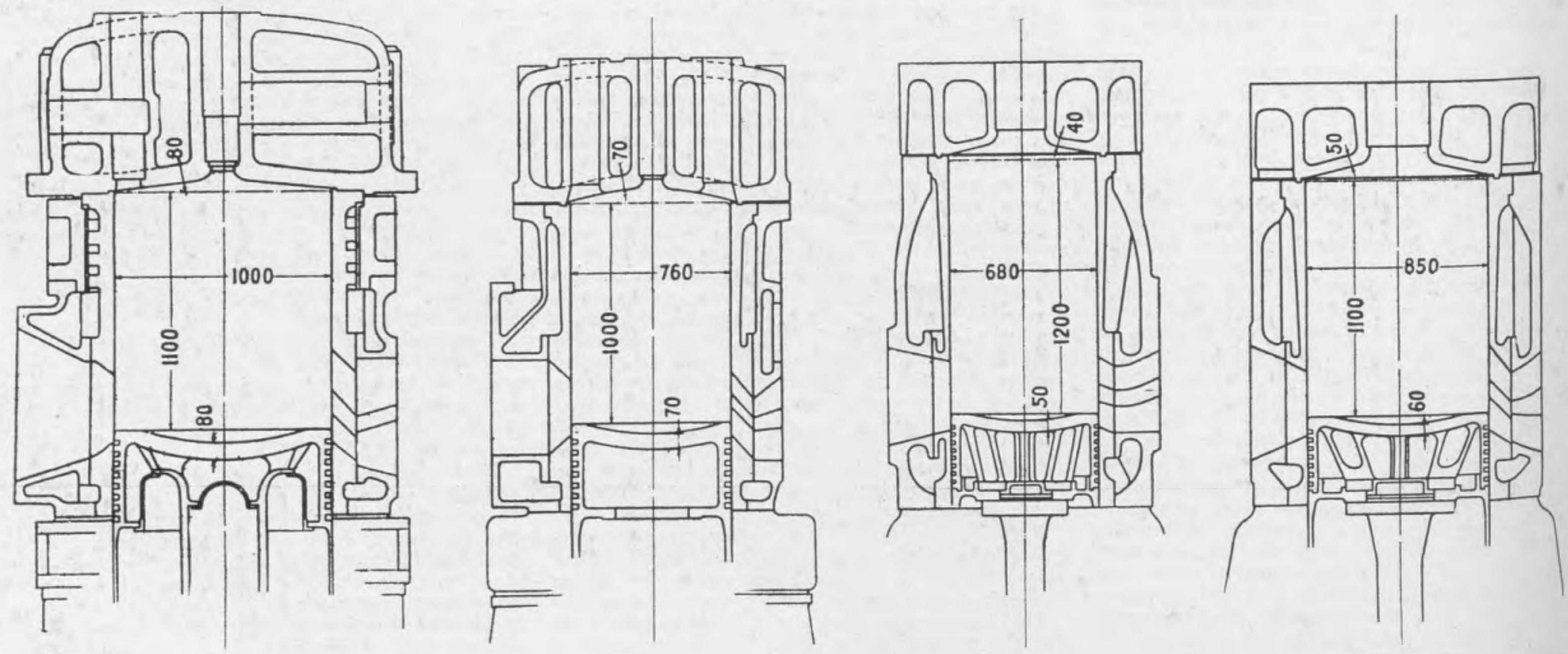
Record of Development of the Sulzer Two-Cycle Oil Engine

PERIOD 1893-1907.—Although Sulzer Bros. first acquired the Diesel patents in 1893, it was not until about 1903 that manufacture was undertaken on an important scale. The first engines were of the four-stroke cycle type with the well-known A design of column. The two-stage air compressor was operated by a lever from the connecting-rod, and compressor intercoolers were introduced at an early date. The torsion spindle type of fuel valve was used. Between 1903 and 1907 approximately seventy engines of this type were built, ranging in power from single-cylinder engines of 25 brake horse-power up to three-cylinder engines of 750 brake horse-power. Even at this period fuel consumptions of the order of 0.416 lb. to 0.417 lb. per brake horse-power hour were attained, with a mechanical efficiency of from 75 to 77 per cent. Early in 1904 a marine installation was built, comprising a 50 brake horse-power engine and a magnetic clutch. The arrangement, though expensive and somewhat complicated, worked well and aroused interest in the application of the Diesel engine to the wider field of marine engineering. During this period experiments were continually made with the object of evolving a two-cycle type of engine which would be lighter in weight and simpler from the point of view of the reversible marine engine. The first engine of this type was constructed in 1905. It was a four-cylinder engine of the high-speed enclosed type, developing 100 brake horse-power at 400 revolutions per minute. Valve scavenging was employed, and in the later forms of design the scavenging pumps and air compressors were driven by a separate crank. As in the case of the modern engines, the thrust block was incorporated in the bed-plate.

Period 1907-1910.—These years were noted for the development in large two-stroke cycle stationary engines for electric generating stations. Valve scavenging continued to be employed, four valves per cylinder being used. The main design of the columns remained unaltered, but the cylinder cover was complicated by the addition of the four scavenging valves. Load on the gudgeon pin calculated on a maximum pressure of 500 lb. per square inch with a pin of 170 mm. diameter, with a total length of 260 mm., worked out at 2200 lb. per square inch on the projected area. No difficulties have been experienced with these bearings, although the loading would be considered extremely high in steam engine practice. In general, the fuel consumption of these engines was considerably higher than that of similar four-stroke engines, largely owing to the high scavenging pressures— 5 lb. to 6 lb. per square inch—which were used. Although at this time the results did not justify a strong policy in favour of the two-stroke cycle engine, the possibility and direction of improvements was clearly indicated.

Period 1910-1915.—A new design with port scavenging eventually led to the permanent adoption of a modified form of port scavenging patented in 1910, which is now recognized as the outstanding distinctive feature of the Sulzer type of engine. The Monte-Penedo, equipped with twin four-cylinder engines of this type, was put into service late in 1912. This vessel, now known as the Sabara, has had a chequered career. Up to the August, 1914, she had run 65,000 miles, the only important defect arising from piston heat

* Extracts from a paper read before the Institution of Engineers and Shipbuilders in Scotland by Eng.-Lieut.-Commander L. J. Le Mesurier.



1912.		1915.		1922.		1922 (design).	
B.H.P. per cylinder	2000	B.H.P. per cylinder	750	B.H.P. per cylinder	500	B.H.P. per cylinder	1250
Revolutions per minute ..	150	Revolutions per minute ..	132	Revolutions per minute ..	100	Revolutions per minute ..	170

Ten years development of the Sulzer cylinder-head design

cracks. The original design of piston has been replaced and no further trouble has been experienced from this cause. The Sabara was interned during the war in Brazil, and was laid up at Messina from 1920 to 1922 owing to legal charter difficulties. The vessel did a further 50,000 miles from the end of the war until the end of 1920. A crank shaft has been replaced, the original design was, it is to be noted, 20 per cent. weaker than Lloyd's standard. The ship is again in Brazilian service.

The 2000 Brake Horse-power Single-cylinder Experimental Engine.—In order to arrive at a definite idea as to the limits of output obtainable in a single cylinder, early in 1914 an experimental engine was built with a cylinder of 1000 mm. bore by 1100 mm. stroke. Exhaustive experiments on scavenging with upper and lower ports were carried out, the trials of this engine being supervised by Dr. H. Stodola. The cylinder head is shown in section in the left-hand view of the drawing reproduced in Fig. 1. It rests on four columns of forged steel, and the cylinder is suspended from the head in such a way as to be capable of expanding freely downwards. Heavy cast iron columns secure transverse rigidity and carry the four slipper guides of the symmetrical crosshead. All working loads are taken by the steel columns, thus relieving the cast iron framing from tensional stresses. Considering that the total working pressure on a piston of these dimensions amounts to over 300 tons, the problem of designing both framework and running parts, particularly the gudgeon pin bearings, was a formidable one. The records of the trials made with the upper row of scavenging ports blanked off and the lower ports only used for scavenging air showed that there was a considerable loss in output and efficiency when scavenging takes place through the lower ports only, and confirmed many other similar experiments with smaller engines as to the advantages of having an upper row of scavenging ports controlled by a valve. The most important effect of these tests was, however, to inspire confidence in the possibility of dealing with the heat stresses and designing satisfactory mechanical arrangements of engines of any power that might reasonably be required either for marine or stationary installations.

At the beginning of 1915 two large marine four-cylinder engines of 1600 brake horse-power, along with auxiliaries, were tested by Dr. Stodola. The war prevented these engines from being installed in their ship, but the test bed results show that even ten years ago there was no difficulty in dealing with the essential problems of a marine Diesel engine developing on overload 500 brake horse-power, or 750 indicated horse-power per cylinder. The dimensions of these engines were as follows:—Four cylinders, each 680 mm. bore by 960 mm. stroke, designed to develop 1600 brake horse-power at a speed of 110 revolutions per minute. The fuel consumption of 0.479 lb. per brake horse-power hour with a scavenge air pressure of 3.1 lb. per square inch is higher than with present-day engines, owing chiefly to the improved scavenging. The engines for the Camranh have the same diameter of cylinders, but with scavenging blowers, and the test results last year gave a figure of 0.411 lb. per brake horse-power for the fuel consumption with a scavenging air pressure of 1.5 lb. per square inch.

Stationary Engines and Small Engines, 1915-1922.—Although engines of the four-stroke cycle type continued to be built in sizes up to 1000 brake horse-power, all engines above this power were exclusively of the two-stroke cycle type, and considerable progress was made in standardization of details and a reduction in the cost of manufacture. The experience gained in the construction of large power units of this type up to 1915 may be gauged by the fact that up to this date twenty-four engines, representing a total of 27,400 brake horse-power, were supplied. These were three and four-cylinder engines in units from 750 to 2000 brake horse-power.

A six-cylinder unit developing 4000 brake horse-power was built in 1915. The cylinder dimensions were 760 mm. bore by 1020 mm. stroke, and the power was developed at a speed of 132 revolutions per minute. [A similar engine was also built for France.—*Editor.*] Some progress was made with the automatic control of the injection air to meet variations in the electrical load, a special governing device being employed. Although many of these large engines were employed in generating stations, a study of the design and working of such engines will well repay the marine engineer.

Marine engineers are inclined to regard the conditions of service in a stationary plant as much less arduous and exacting than those which obtain in a marine installation. While it must certainly be recognized that the Diesel engine has to be designed to meet the special conditions arising in each case, it is by no means to be taken for granted that the marine conditions are more difficult to fulfil. The stationary plant coupled to a generator has, for instance, to maintain a uniform speed under widely varying conditions of load, and, apart from the difficulty in providing an efficient governing arrangement, the engine does not settle down to a favorable steady condition of temperature such as is obtained during the prolonged running usual with a marine engine.

Turning to the smaller engines, until a few years ago it was Sulzer practice to make all small stationary engines and marine auxiliary engines of the ordinary four-cycle Diesel type with air injection. The latest (RV) type of engine for such purposes is a two-cycle engine with airless injection and crank case scavenging, in which latter feature the engine bears a resemblance to the well-known semi-Diesel or hot-bulb engine. The compression pressure is about 450 lb. per square inch, and is sufficient to cause ignition as in an ordinary Diesel engine; there is thus no necessity for a hot bulb, and the fuel consumption is approximately the same as would be obtained by a Diesel engine with air injection. Compressed air stored at a pressure of 300 lb. to 100 lb. per square inch is used for starting purposes, and is supplied by a small two-stage compressor, which may be either coupled to the engine or hand operated.

For locomotive work the same system of fuel injection is used, but the engine, being of the V type, does not lend itself readily to crank case scavenging, and the four-stroke cycle is chosen. A further advantage of the four-cycle type is that the temperature of the exhaust being much higher than in a two-cycle engine, the exhaust gases are available for heating purposes.

Marine Engines, 1915-1922.—The war greatly handicapped the manufacture of marine engines for merchant vessels, but during this period many engines were built for gunboats, naval patrol vessels, tugs, &c., of a design applicable to merchant vessels, totaling in all over 45,000 brake horse-power. In addition, about sixty submarine engines were built, the aggregate power being about 50,000 brake horse-power; the largest unit was an eight-cylinder engine of 3500 brake horse-power running at 300 revolutions per minute. All these engines were of the two-cycle type with controlled port scavenging. In the earlier engines the valve controlling the upper port was of the double-beat type, operated by cams in a similar manner to the valves shown in the stationary engines, but later a simplification was effected by using a rotary valve which revolves at half the crank shaft speed. A further simplification was the introduction of a new form of cylinder cover, having one central opening, and all necessary valves, including the fuel valve, air starting valve and decompression valve, grouped in the one centrally placed valve casing. Improvements in reversing gear and the controlling servo-motors were also made. For the larger powers turbo-blowers were introduced, resulting in saving in weight and space, especially important in submarine construction. In cases where steam auxiliaries are employed steam turbine-driven blow-

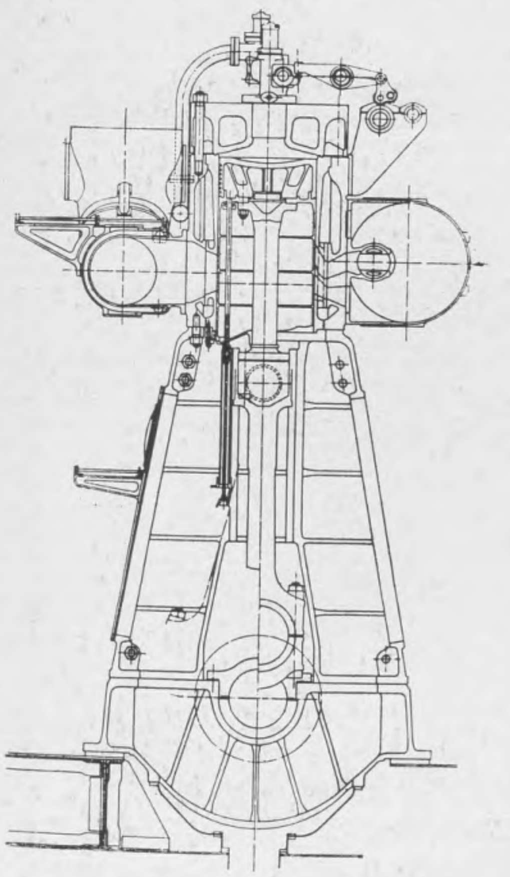


Fig. 2.—Section through 10,000-b.h.p. engine

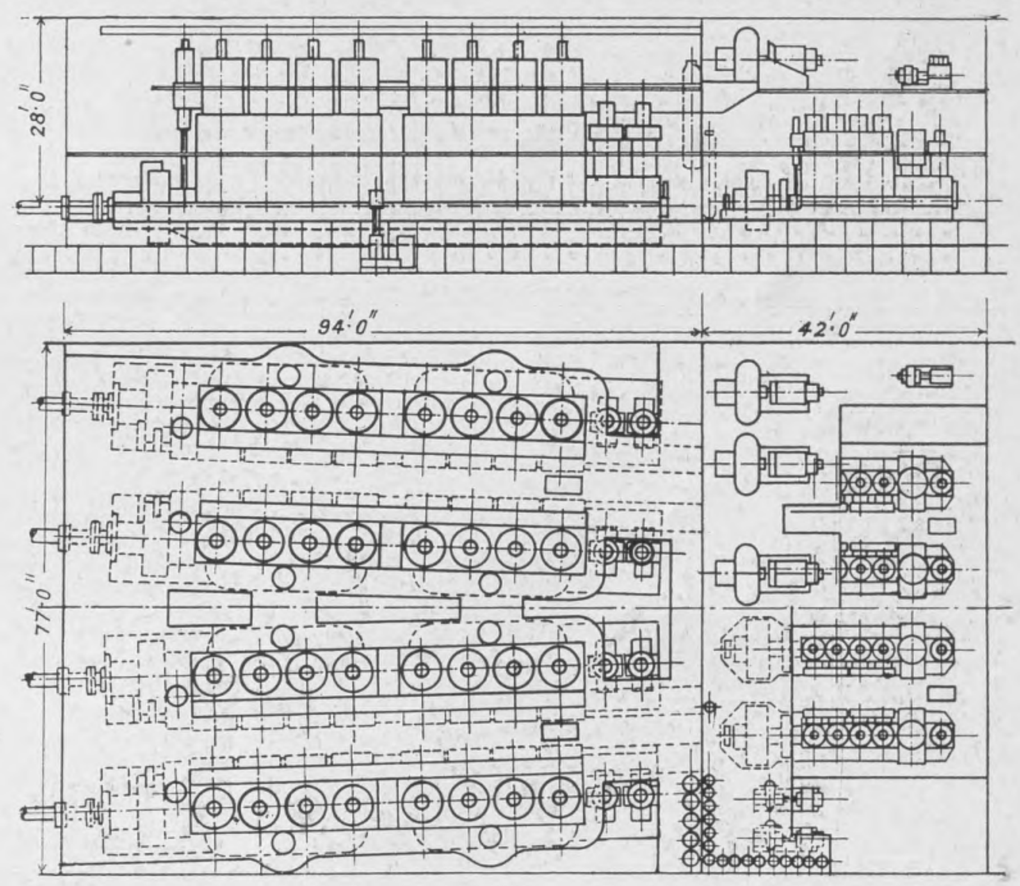


Fig. 3.—Machinery arrangement for proposed 40,000-b.h.p. naval vessel

ers may be used instead of blowers driven by high-speed electric motors. The twin-screw motorship Handicap, with a machinery installation of 2700 shaft horse-power, is fitted with turbo-blower, electrically driven and running at a speed of about 2700 revolutions per minute. The results so far obtained from this ship have been entirely satisfactory, the vessel having covered approximately 49,000 sea miles from December, 1921 to January, 1923.

Other examples of the present-day design of marine engines are the engines installed in the Conde de Churruca and the machinery which has recently been completed for the motor ship Camranh. In the case of the latter ship the arrangement of main engines will be similar to that adopted on the Handicap, but the cylinder dimensions are larger.

Large Marine Engines.—The motor passenger liner of 13,000 brake horse-power now under construction at the Fairfield yards represents a notable advance in the progress of the motor ship. Being a four-shaft ship, the engines themselves are of a comparatively moderate power, and all the essential problems have long since been dealt with and solved satisfactorily. It is perhaps interesting to speculate upon the maximum power per unit that may be obtained without taking either undue risks or departing from the general design of single-acting two-cycle Sulzer engines already described. As the machinery installations of all merchant vessels, with the exception of fast passenger liners, will certainly fall within this maximum, it is proposed to examine a project for a naval vessel having four shafts and developing 40,000 brake horse-power with eight-cylinder engines running at 170 revolutions per minute. The proposed machinery would be as follows:

	Main engines	Auxiliary engines
Number of engines	4	4
Number of cylinders per engine	8	4
Diameter of cylinder, mm.	850	470
Stroke of cylinder, mm.	1,100	600
Brake horse-power per engine	10,000	1,000
Indicated horse-power per engine	12,600	1,430
Revolutions per minute	170	240
Piston speed in feet per minute	1,230	945
Indicated mean pressure, pounds per square inch	94.5	92

The turbo-blowers and cooling water pumps are electrically driven and absorb per main engine approximately 700 brake horse-power, supplied by the auxiliary engines.

The total weight of the main and auxiliary engines, turbo-blowers and pumps with their motors, air reservoirs, compressors, silencers, &c., amounts to about 2750 tons. The weight is thus 150 lb. per brake horse-power, which compares with about 70 lb. per brake horse-power for submarines, and 290 lb. per brake horse-power for ordinary cargo vessels fitted with Sulzer two-cycle main and auxiliary engines.

The following table shows a comparison with the proposed design embodying the following engines:

Type	Stationary	Submarine	Cargo vessel	Proposed engine
Weight of one main engine in tons	344	74.5	204	525
Weight of one corresponding auxiliary engine without dynamo	—	16	17	67
Brake horse-power (total)	4,500	3,500	2,000	10,000
Brake horse-power per cylinder	750	435	500	1,250
Revolutions per minute	132	300	100	170
Cylinder diameter, mm.	760	540	680	850
Cylinder diameter, inches	30.4	21.3	26.8	33.5
Cylinder stroke, mm.	1,020	570	1,200	1,100
Cylinder stroke, inches	40	22.4	46.5	43.4
Piston speed, feet per minute	885	1,120	790	1,230
Indicated mean pressure in lb. per square inch	94	100	93	94.5
Weight of engine in tons per cubic foot of stroke volume	3.42	2.02	3.30	2.98

(1) Stationary engine of 4000 brake horse-power with six cylinders, completed in 1915, having direct-driven scavenging pumps. With separate electrically driven scavenging blowers the power would be 4500 brake horse-power when working with the same indicated mean pressure, and for purposes of comparison this power has been assumed.

(2) Submarine engine of 3500 brake horse-power having eight cylinders, with separate electrically driven scavenging blowers. This engine developed 3745 brake horse-power while on trial in 1920.

(3) Standard marine engine of 2000 brake horse-power, having four cylinders and separate electrically driven scavenging blower.

Piston Speed.—In accordance with the usual practice for naval machinery, the piston speed is higher than in other examples of actual engines, but this does not present any difficulty as regards scavenging and charging the cylinder, while as regards the mechanical arrangements, due consideration is given to reducing the reciprocating and rotating masses by using material of greater tensile strength. In submarine engines built by the M.A.N. Company piston speeds as high as 1470 ft. per minute have been successfully realized in practice.

Mean Pressure.—A very moderate indicated mean pressure of only 94.5 lb. per square inch has been chosen, which should allow for a good margin of overload. The 1250 brake horse-power engines in the Conde de Churruca have worked continuously for long periods at indicated mean pressures of about 117 lb. per square inch without any visible signs of overload and with a clear exhaust.

Fig. 1 shows a comparison between the proposed design of cylinder and some designs of cylinders already constructed. Progress has been in the direction of simplifying the castings of liners, cylinder covers, and pistons, and in providing large cooling water spaces free from any obstruction. It has also been found possible, owing to improvements in design, to lessen the thickness of material in the above-mentioned parts, thereby reducing stresses due to the temperature difference between their inner and outer surfaces. On the whole the thermal conditions in the proposed design are therefore more favorable than in either the experimental 2000 horse-power single-cylinder engine or the 4000 horse-power engine, which has been in service for about six years.

The weight of the proposed engine per cubic foot of cylinder volume lies between the weight of a stationary engine and submarine engine measured on the same basis. The submarine engine, owing to limited head room, requires a much smaller stroke-bore ratio, namely, 1.05, whereas the proposed design allows of a ratio of 1.3, which is more favorable, as it increases the mechanical efficiency from about 68 to 74 per cent.

In calculating the efficiency the power for driving the scavenging pumps is deducted from the total brake horse-power of the engine. Thus the efficiency of the proposed engine is 10,000 minus 700 divided by 12,600, or 74 per cent.

Taking into account the comparatively light moving masses, the total weight allows of sufficient material being put into the bed-plate, framing, and cylinders to ensure adequate rigidity of the whole structure.

Fig. 2 shows a section through the engine which does not differ in any essential feature from the standard type of Sulzer marine engine, while Fig. 3 shows a general arrangement of the machinery with four shafts in a ship of 77 ft. beam, the total length of the machinery space being about 136 ft.

Among the advantages that may be mentioned for a naval vessel equipped with Diesel instead of steam machinery are:

(1) Increased radius of action on a given supply of fuel. In the proposal described the consumption of fuel at full power would not exceed 185 tons per day, or less than half the weight required for a steam vessel of the same power.

(2) The ability to proceed to sea at short notice or to increase rapidly from cruising to full speed.

(3) Absence of uptakes and funnels, with consequent advantages in the disposition of armament and in less vulnerability to attack from above, owing to the reduced area of openings in the armour deck. In an aircraft carrier a perfectly free landing deck can be easily provided.

(4) Risk of being put out of action by damage to steam pipes or boilers entirely eliminated.

These advantages would appear sufficiently important to induce naval constructors to study the possibilities of high-powered Diesel engines, the employment of which in naval craft would doubtless lead to results not less far reaching than may be confidently expected from the 13,000 brake horse-power passenger liner now under construction by the Fairfield Shipbuilding and Engineering Company, Limited.

OIL-ENGINE NOMENCLATURE

Report of the Sub-Committee Appointed by the Council of the British Institution of Mechanical Engineers

(1.) The Committee has given consideration to various suggestions and schemes of nomenclature emanating from the Chairman, individual Members and from its Sub-Committee; to correspondence and pamphlets addressed to it by Herbert Akroyd-Stuart; to dossiers submitted by the Admiralty and the Department of Scientific and Industrial Research; to representations from the British Engineering Standards Association; and to replies to inquiries, made on its behalf by Mr. Pendred, as to the existence or otherwise of approved nomenclature of oil-engines by Engineering Institutions in France and in the United States of America.

(2.) The Committee is of the opinion that the modern oil engine, as distinct from the automobile type of liquid-fuel engine, has been evolved mainly from the principles enunciated by Herbert Akroyd-Stuart in his Patent No. 7146 of 8th May, 1890, and, as embodied in the engine constructed at Bletchley (Buckinghamshire) and tested by Professor William Robinson, a Member of the Committee, in February, 1891. Professor Robinson referred to this engine in detail in a paper, "The Uses of Petroleum in Prime Movers," read on 29th April, 1891, and subsequently published in the Journal of the Society of Arts. This "Akroyd" engine is the prototype of those in which the liquid fuel is introduced into a compressed or partially compressed charge of air, and which do not need an extraneous source of ignition. In this respect the "Akroyd" engine anticipated the engine subsequently evolved in Augsburg, Germany, by the Maschinenfabrik Augsburg Nurnberg from the original proposals of Rudolph Diesel in 1893 and described by H. Ade Clark in his paper, "The Diesel Engine," read before the Institution at the meeting in Leeds in July, 1903. It may thus be said that the pioneer work of Herbert Akroyd-Stuart has been adversely cloaked by nomenclature.

(3.) In the development of modern oil engines, departures have been made both from the "Akroyd" and the "Diesel" original principles, and to designate these by inventors' names would be misleading and depreciative of the work of those to whose efforts the recent successes achieved have been due. The various types of engines merge so intricately that arbitrary grouping for the purposes of nomenclature would be unsatisfactory. For commercial exploitation, trade names cannot be dispensed with and, after all, these are usually sufficiently distinctive for general use.

(4.) The Committee considers that the term "Semi-Diesel" as applied to oil engines is subversive of the fact that this type of oil engine is a British production and an evolution from the "Akroyd" engine.

(5.) After careful consideration, the Committee has been forced to the conclusion that an extended classification would be of little value, and that it is improbable that any system of nomenclature could be devised to cover all divergent points of detail and to meet practical requirements.